Fishery Data Series No. 11-28

Takotna River Salmon Studies, 2010

Annual Report for Study 08-304
USFWS Office of Subsistence Management
Fisheries Resource Monitoring Program

by

Tracy R. Hansen

and

Christopher A. Shelden

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Alaska Department of Fish and Game — Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	\$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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by
Tracy R. Hansen
and
Christopher A. Shelden
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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Tracy R. Hansen (tracy.hansen1@alaska.gov)

and

Christopher A. Shelden (chris.shelden@alaska.gov)

Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518-1599, USA

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ABSTRACT

The Takotna River, a tributary of the Kuskokwim River, produces Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, and coho salmon *O. kisutch* that contribute to subsistence and commercial salmon fisheries downstream of its confluence with the mainstem. A weir has been operated annually on the Takotna River since 2000, and is part of an array of projects used to monitor salmon escapement in the Kuskokwim River drainage. Salmon were enumerated by species as they migrated through the weir to determine daily and annual escapements. Samples were collected to estimate the age, sex, and length composition of escapements using a live trap.

Total escapements of 178 Chinook, 4,062 chum, 8 sockeye *O. nerka*, and 3,217 coho salmon were determined for the target operational period 24 June to 20 September, 2010. Chinook and chum salmon escapements were below their historical medians, while coho salmon escapement was near its historical median. Age, sex, and length composition was not estimated for the Chinook salmon escapement due to suspected sampling bias. The age composition of the chum salmon escapement was estimated to be 80% age-0.3, 10% age-0.2, 10% age-0.4, and less than 1% age-0.5, with 55% female overall. The age composition of the coho salmon escapement was estimated to be 93% age-2.1, 5% age-1.1, and 2% age-3.1, with 54% female overall.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *O. keta*, coho salmon, *O. kisutch*, longnose suckers, *Catostomus catostomus*, escapement, ASL, age-sex-length, salmon age composition, salmon sex composition, salmon length composition, Takotna River, Kuskokwim River, resistance board weir, radiotelemetry, mark–recapture, stock specific run-timing.

INTRODUCTION

Draining an area approximately 130,000 km^2 (11% of the total area of the state), the Kuskokwim River is the second largest river in Alaska (Figure 1; Brown 1983). Each year mature Pacific salmon *Oncorhynchus* spp. return to the river and its tributaries to spawn, supporting an annual average subsistence and commercial harvest of approximately 650,000 salmon in recent years (Bavilla et al. 2010). The subsistence salmon fishery in the Kuskokwim Area is one of the largest in the state and remains a fundamental component of local culture (Coffing 1991; Coffing[1]; Coffing et al. 2000; Carroll and Patton 2010; Bavilla et al. 2010). The commercial salmon fishery has been an important component of the market economy of lower Kuskokwim River communities (Buklis 1999; Bavilla et al. 2010). Salmon contributing to these fisheries spawn and rear in nearly every tributary of the Kuskokwim River basin.

Since 1960, Kuskokwim River subsistence, commercial, and sport fisheries have been the responsibility of the Alaska Department of Fish and Game (ADF&G), though other agencies contribute to management decisions. Management authority for the subsistence fishery was broadened in October 1999 to include the federal government under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). The U.S. Fish and Wildlife Service (USFWS) is the federal agency most involved within the Kuskokwim Area. In addition, numerous tribal groups such as the Takotna Tribal Council (TTC) are charged by their constituency to actively promote a healthy and sustainable subsistence salmon fishery. These groups, and others, have combined their resources in a common effort to promote sustainable management of Kuskokwim River salmon.

In the State of Alaska, salmon management seeks to provide for sustainable fisheries by ensuring that adequate numbers of salmon escape to the spawning grounds each year (5 AAC 39.222).

[1] Coffing, M. *Unpublished* a. Kuskokwim area subsistence salmon harvest summary, 1996; prepared for the Alaska Board of Fisheries, Fairbanks, Alaska, December 2, 1997. Alaska Department of Fish and Game, Division of Subsistence, Bethel.

Coffing, M. *Unpublished* b. Kuskokwim area subsistence salmon fishery; prepared for the Alaska Board of Fisheries, Fairbanks, Alaska, December 2, 1997. Alaska Department of Fish and Game, Division of Subsistence, Bethel.

Achievement of this goal requires an array of long-term escapement monitoring projects that 1) reliably measure annual escapement to key spawning systems, and 2) track temporal and spatial patterns in abundance; which influence management decisions. Over time and with sufficient data, escapement goals can be developed as a means to gauge escapement adequacy, but current spawner–recruit models for escapement goal development require many years of data. For much of ADF&G management history in the Kuskokwim Area, escapement monitoring has been limited to aerial surveys and 2 ground based escapement monitoring projects.

Salmon spawn in dozens of tributaries in the Kuskokwim drainage and the operation of only 2 escapement monitoring projects was not an adequate measure of the entire Kuskokwim River basin. This problem was answered with the addition of several escapement monitoring projects in the mid to late 1990s, including the Takotna River weir. The data provided by the current array of projects have much greater utility for fishery managers and have decreased their reliance on aerial stream surveys, which are known to be imprecise (Holmes and Burkett 1996; Molyneaux and Brannian 2006; Mundy 1998). In addition, main-river tagging studies rely on the expanded weir infrastructure to estimate inriver abundance and develop run reconstruction models for Kuskokwim River salmon. Run reconstruction models that result from these studies will be an important tool in answering questions of exploitation, distribution, and abundance for Kuskokwim River salmon and may eventually lead to the development of escapement goals for the entire Kuskokwim River drainage. These projects have since become deeply integrated components of Kuskokwim River salmon management.

The Takotna River weir also serves as a platform for collecting information on habitat variables. These include water temperature, water chemistry, and stream discharge (water level). These variables may directly or indirectly influence salmon productivity and timing of salmon migrations but do not yet figure prominently into management strategies (Hauer and Hill 1996; Kruse 1998; Quinn 2005). These variables can be affected by human activities (i.e., mining, timber harvesting, man-made impoundments, etc.; NRC 1996) or broader climatic variability (e.g., El Nino and La Nina events, climate change).

BACKGROUND

Since monitoring began, Takotna River salmon escapements of all species have been relatively small; however, historical accounts suggest that salmon abundance was once much higher. In the early 1900s, salmon were harvested from the Takotna River by small bands of Athabaskans including residents of Tagholjitdochak', a now abandoned village site located near the confluence of Fourth of July Creek. The Takotna River also hosted immigration of residents from the Vinasale and Tatlawiksuk Athabaskan bands who maintained small seasonal camps in the Takotna River drainage (Figure 2; Anderson 1977; BLM 1984; Hosley 1966; Stokes 1983; Stokes 1985). The numbers of salmon these groups harvested is unknown, but Nikolai elders suggest that there were strong runs of Chinook *O. tshawytscha* and chum *O. keta* salmon in the Takotna River as recently as the early twentieth century (Stokes 1985).

The historical harvest method used by native Athabaskans was a weir constructed of spruce poles and fitted with a fish trap. According to Nikolai elders, at least 4 such weirs were located on the Takotna River (Figure 2; Stokes 1983). One of these was located on the Nixon Fork of the Takotna River near the confluence of the West Fork River. Other locations included a site on the main river a short distance above the current community of Takotna; one near Big Creek (lower); and another near or within Fourth of July Creek. The site near Fourth of July Creek is believed to have been operated by residents of Tagholjitdochak' (Stokes 1983). These sites were all abandoned by the mid-1920s (Stokes 1983).

The discovery of gold in the Innoko mining district in 1906 was a catalyst for social change and may have been a significant factor in the near extirpation of salmon in the Takotna River. The community of Takotna developed as a staging area for miners who used the Takotna River as an access route to mining operations that were mostly located in the Yukon River drainage (Brown 1983). The thousands of miners and related support personnel that migrated into the area were dependent on dog teams for winter transportation. The community of Takotna served as a major summer kenneling area and salmon was a common food source for the dogs.

Steamboats navigated as far upstream as the current community of Takotna and probably had an adverse effect on local salmon stocks. A Kusko Times article published in 1921 references the construction of small temporary dams on the Takotna River to facilitate steamboat passage (Kusko Times 1921). We have been unable to uncover any details about these dams, but they may have contributed to salmon declines by altering stream habitat or creating obstructions to migration. Stokes (1985) conducted interviews with residents as part of a study of subsistence harvest activities in the upper Kuskokwim River, but residents were unclear about the cause and timing of declines in salmon harvest. Stokes (1985), after reviewing historical accounts, concluded that it was likely a combination of overfishing and habitat alteration associated with mining development, and not a result of traditional harvest practices, that led to the decline.

Area residents and local biologists described the Takotna River as being nearly devoid of salmon during the 1960s and 1970s (Molyneaux et al. 2000). By the 1980s, however, Takotna residents began to notice adult salmon in the river again. Around 1990 rod and reel fishermen began to catch coho salmon *O. kisutch* while fishing for northern pike *Esox lucius* (Dick Newton, local resident, Takotna; personal communication). During an aerial survey in 1994, an experienced ADF&G fishery biologist observed several thousand chum salmon and some Chinook salmon in Fourth of July Creek, but few salmon were observed elsewhere in the drainage (Burkey and Salomone 1999).

The perception of recovering salmon abundance inspired interest among ADF&G staff and local residents and prompted the development of a project designed to document the numbers of spawning salmon returning to the Takotna River. Initially, high school students built a salmon counting tower that they operated from 1995 to 1999, but success was limited because of poor water clarity, periodic high water levels, and organizational difficulties (Molyneaux et al. 2000). The monitoring project transitioned to a resistance board weir in 2000 (Schwanke et al. 2001) as one of several initiatives started in the late 1990s to improve salmon escapement monitoring in the Kuskokwim Area. The Takotna River weir has operated successfully every year since inception and is currently the farthest upstream ground-based salmon escapement monitoring project in the Kuskokwim River drainage and is an integral part of our drainage-wide initiative to understand the dynamics of Kuskokwim River salmon.

The Takotna River weir is operated jointly by ADF&G Division of Commercial Fisheries and the TTC. ADF&G staff help oversee inseason operations and serve as the principal agent for data management, data analysis, and report writing. The TTC provides most of the field crew and coordinates much of the preseason preparations and inseason operations.

Objectives

The annual objectives of the Takotna River escapement monitoring project (FIS 08-304) were to:

1. Determine daily and total escapements of male and female Chinook, chum, sockeye *O. nerka*, and coho salmon in the Takotna River upstream of the community of Takotna during the target operational period of 24 June to 20 September;
2. Estimate the age, sex, and length composition of annual Chinook, chum, and coho salmon escapements to the Takotna River such that 95% confidence intervals for the age composition are no wider than ±10% (α=0.05 and d=0.10);
3. Mentor high school students through the TTC high school internship program; and,
4. Facilitate other fisheries research projects by:
    a. Collection of escapement and ASL data for development and maintenance of salmon run reconstruction models and other management tools for the entire Kuskokwim River;
    b. Installing and monitoring air and stream thermographs at Takotna River weir as part of a broader *Temperature Monitoring* project.

METHODS

Study Area

The Takotna River originates in the central Kuskokwim Mountains of the upper Kuskokwim River basin (Figure 1). Formed by the confluence of Moore Creek and Little Waldren Fork, the river flows northeasterly and passes the community of Takotna at river kilometer (rkm) 80, before turning southeasterly near the confluence of the Nixon Fork at rkm 24 (Figure 2; Brown 1983). The Tatalina River joins at rkm 4.8, and then the Takotna River empties into the Kuskokwim River across from McGrath at rkm 752 of the Kuskokwim River.

The Takotna River is about 160 km in length and drains an area of 5,646 sq km (Brown 1983). The river is shallow with many meanders from its headwaters to the community of Takotna, but gradually becomes deeper downstream of that point, especially after the confluence with the Nixon Fork. In the lower reaches, the current is sluggish and the channel width averages 122 to 152 m. The river’s average slope is about 89 cm per km (Brown 1983).

At normal flow, the Takotna River has a nominal load of suspended materials, and the water is stained due to organic leaching. The Nixon Fork and Tatalina rivers drain extensive bog flats and swampy lowlands, but the remainder of the basin is primarily upland spruce-hardwood forest (Brown 1983; Selkregg 1976). White spruce *Picea glauca*, birch *Betula* spp., and aspen *Populus tremuloides* are common on moderate south-facing slopes; while black spruce *P. mariana* is more characteristic of northern exposures and poorly drained flat areas. The understory consists of spongy moss and low brush on the cool, moist slopes, grasses on the dry slopes, and willow *Salix* spp. and alder *Alnus* spp. in the higher open forest near the timberline.

A weir has been installed annually since 2000 at N 62° 58.1', W 156° 05.9', several hundred meters upstream of the Takotna River Bridge near the community of Takotna. This site allows for enumeration of nearly all spawing salmon in the Takotna River drainage only excluding those in the Nixon Fork tributary. The river channel at this site is about 85 m wide and has a wetted depth of less than 1 m during normal summer flows. The substrate is composed mostly of gravel with sand and cobble also present.

WEIR DESIGN

The resistance board weir was installed across the entire 85 m channel following the techniques described by Stewart (2003). The substrate rail and resistance board panels covered the middle 75 m portion of the channel, and fixed weir materials extended the weir 5 m to each bank. Details of design and materials used to construct the weir are described in Tobin (1994) with panel modifications described by Stewart (2002). The Takotna River weir was designed with a gap of 4.29 cm (1-11/16 in) between each picket.

A live trap and skiff gate were installed within the deeper portion of the channel. The live trap was designed as the primary means of upstream fish passage. The trap could be easily configured to pass fish freely upstream, capture individual fish for tag recovery, or trap numerous fish for collection of age sex length (ASL) or genetic samples. The skiff gate allowed boat operators to pass with little or no involvement of the weir crew as the weight of a boat submerged the passage panels and allowed boats to pass over the weir. Boats with jet-drive engines were the most common and could pass up or downstream over the skiff gate after reducing speed to 5 miles per hour or less.

To accommodate downstream migration of longnose suckers *Catostomus catostomus* and other non-salmon species, downstream passage chutes were installed into the weir. Chutes were created by releasing the resistance boards on 1 or 2 adjacent weir panels so the distal ends dipped slightly below the stream surface. The chute's shallow profile guided downstream migrants over the weir while preventing upstream salmon passage. The chutes were monitored and adjusted to ensure salmon were not passing upstream. Downstream salmon passage was not enumerated; however, few salmon have been observed passing downstream over these chutes, and their numbers are considered negligible.

ESCAPEMENT MONITORING

A target operational period, spanning most of the salmon runs, was used to provide for consistent comparisons of annual escapements among years. The target operational period for Takotna River weir has been established as 24 June through 20 September, although actual operational dates may vary annually with stream conditions. Daily and total annual escapements consisted of the observed passage plus any estimated passage of Chinook, sockeye, chum, or coho salmon missed during the target operational period. Counts of all other species were reported simply as observed passage.

Passage Counts

Passage counts were conducted periodically during daylight hours. Delays in fish passage occurred only at night or during ASL sampling. Crew members visually identified each fish as it passed upstream and recorded it by species on a multiple tally counter. Counting continued for a minimum of 1 hour, or until passage waned. This schedule was adjusted as needed to accommodate the migratory behavior and abundance of fish, or operational constraints such as reduced visibility in evening hours late in the season. Crew members recorded the total upstream fish count in a designated notebook and zeroed the tally counter after each counting session. At the end of each day, total daily and cumulative seasonal counts were copied to logbook forms. These counts were reported each morning to ADF&G staff in Bethel via email.

Salmon were also identified and enumerated by sex, based on visual characteristics of advanced sexual dimorphism apparent in mature salmon at Takotna River weir. This data is not considered a conclusive determination of sex, but instead may serve as a means of assessing bias in ASL sampling.

Passage Estimates

Upstream salmon passage was estimated for days the weir was inoperable. Inoperable periods resulted from breaches in the weir, a delayed start date, and a premature end date. Estimates were assumed to be zero if passage was likely negligible based on historical or inseason data. Otherwise, estimates for missed passage were calculated using one of the following methods:

Single Day Method

When the weir was not operational for all of one day, an estimate for the inoperable day was calculated using the following formula:

$$\hat{n}_{d_i} = \frac{\left(n_{d_i-2} + n_{d_i-1} + n_{d_i+1} + n_{d_i+2}\right)}{4} \tag{1}$$

Where:

$n_{d_i-1}, n_{d_i-2} =$ observed passage of 1, 2 days before the weir was washed out;

$n_{d_i+1}, n_{d_i+2} =$ observed passage of 1, 2 days after the weir was reinstalled.

If any passage was observed on a day when the weir was not fully operational, those fish were subtracted from the daily passage to convey what proportion was actually estimated. The proportion of estimated missed passage provides insight on accuracy. Since error is associated with any estimation method, years with greater proportions of estimated passage can be considered less accurate compared to years with smaller proportions.

The daily estimated missed passage $\hat{n}_{d_i}$ will always be reported except for when it is less than the observed passage, as the estimate will be disregarded and observed passage will then be considered the daily passage.

Linear Method

When the weir was not operational for 2 or more days but later became operational again, passage estimates for the inoperable days ($d_1,\ldots,d_i$) were calculated using the following formula:

$$\hat{n}_{d_i} = (\alpha + \beta \cdot i) \tag{2}$$

$$\alpha = \frac{n_{d_1-1} + n_{d_1-2}}{2}$$

$$\beta = \frac{\left(n_{d_i+1} + n_{d_i+2}\right) - \left(n_{d_1-1} + n_{d_1-2}\right)}{2(i+1)}$$

Where:

$n_{d_1 - I,} n_{d_1 - 2}$ = observed passage for the first and second days before the inoperable period,

$n_{d_i + 1,} n_{d_i + 2}$ = observed passage the first and second day after the weir was reinstalled.

Exponential Method

When the weir was not operational for the beginning or end of a run, a non-linear regression was used to fit an exponential function to existing data. For estimating the end of a run, we used the falling limb of the run curve to fit an exponential trend line. Using this method the trendline was fitted to the data using the exponential function:

$$\hat{n}_{d_i} = ae^{bi} \tag{3}$$

Where:

a = y-intercept of the fitted line

b = slope of the fitted line

i = day of the estimated portion of the run as represented by the run curve

Carcass Counts

The weir was typically cleaned and inspected after the first and last counts of each day. Dead or spawned out live salmon that washed up on the weir, both referred to hereafter as carcasses, were counted by species and sex and passed downstream during each cleaning. These counts are not considered a census, as both the skiff gate and downstream passage chutes installed to facilitate migration of non-salmon species provide a pathway for dead and dying salmon to pass downstream uncounted.

AGE, SEX, AND LENGTH COMPOSITION

To estimate the age, sex, and length composition of annual Chinook, chum, and coho salmon escapements, live sampling was conducted as fish migrated upstream through the weir. Samples were collected throughout the season to account for temporal dynamics in ASL characteristics. Samples were stratified postseason to develop weighted estimates.

Sample Size and Distribution

A minimum sample size was determined for each species following conventions described by Bromaghin (1993) to achieve 95% confidence intervals of age-sex composition for each sample be no wider than ±10% (α=0.05 and d=0.10), assuming 10 age-sex categories for Chinook salmon (n=190), 8 age-sex categories for chum salmon (n=180), and 6 age-sex categories for coho salmon (n=168), and unknown population size. Because the Takotna River Chinook salmon population is small, the sample size of 190 was corrected for a population of 500 fish using the finite population correction:

$$n' = \frac{n}{1 + \left(\frac{n-1}{N} \right)} \tag{2}$$

Where:

n = sample size of unknown population size;

N = estimated normal population size; and,

n' = sample size corrected for a known population size.

Minimum sample sizes for each species were then increased by about 20% to account for unreadable scales or collection errors. This yielded a minimum collection goal for each sample of 165 Chinook, 220 chum, and 200 coho salmon.

A pulse sampling strategy was employed to ensure adequate temporal distribution of chum and coho samples. The term "pulse" is used to describe a sample collected over a few days and applied to a longer period. Pulse sampling was conducted approximately every 7–10 days. The goal was to collect a minimum of one pulse sample from each third of the run. Well spaced pulse samples may have greater power for detecting temporal changes in ASL composition than other sampling methods (Geiger and Wilbur 1990).

The relatively low abundance of Chinook salmon at Takotna River weir makes pulse sampling impractical. Instead, the sample was collected continuously over the run following a daily collection schedule based on historical run timing information. Daily sample sizes were proportional to average historical escapements by day to ensure a good distribution across the run. The overall sample size was selected to exceed the minimum necessary to meet precision and accuracy criteria for this location and was similar to average historical sampling success.

Sample Collection Procedures

Salmon were sampled using the live trap installed in the weir. Salmon were trapped by opening the entrance gate while the exit gate remained closed. Fish were allowed to swim freely into the live trap, and the V-shape positioning of the entrance gate prevented them from easily escaping. The live trap was allowed to fill with fish until a reasonable number was inside. Crew members used a short-handled dip net to capture fish within the live trap. To obtain length data and aid in scale collection, fish were removed from the dip net and placed into a partially submerged fish "cradle." Scales were taken from the preferred area of the fish (INPFC 1963) and transferred to numbered gum cards as described in Molyneaux et al. (2010). Sex was determined through visual examination of the external morphology, focusing on the prominence of a kype, roundness of the belly, and the presence or absence of an ovipositor. Mideye fork (MEF) length was measured to the nearest millimeter using a straight-edged meter stick. Sex and length data were recorded on standardized numbered data sheets that correspond with numbers on the gum cards used for scale preservation. After sampling, each fish was released upstream of the weir. The procedure was repeated until the live trap was emptied to ensure no bias was introduced.

Chinook salmon samples were often collected through "active sampling," which consisted of capturing and individually sampling while actively passing and counting all salmon. To prevent bias, active sampling was conducted on each Chinook salmon individual observed during the sampling/passing procedure. Further details of the active sampling procedures are described in Linderman et al. (2002).

After sampling was completed, relevant information such as sex, length, sampling date, and sampling location was transferred to a Microsoft Excel®[2] spreadsheet that corresponded to numbered gum cards. The completed gum cards were sent to the Bethel and/or Anchorage ADF&G offices for processing. The original ASL gum cards, acetates, and Excel data were archived at the ADF&G office in Anchorage. The computer files were archived by ADF&G in the Anchorage and Bethel offices. Data were also loaded into the Arctic-Yukon-Kuskokwim (AYK) salmon database management system (Brannian et al. 2006).

Data Processing and Reporting

Samples were aged and processed by ADF&G staff in Bethel and Anchorage following procedures describe by Molyneaux et al. (2010). Samples were partitioned postseason into temporal strata, based on overall distribution within the run. The escapement in each stratum was divided into age-sex classes proportionately with strata sample composition. Mean length by age-sex class was determined for each stratum as well. Annual estimates were calculated as strata sums, weighted by the abundance in each stratum. When sample size or distribution was not considered adequate to estimate annual ASL composition, results were reported, but not applied to annual escapements.

Summary tables were generated for each species. Tables provided age-sex class percentages and mean length-at-age by sex (both determined by samples) for each stratum; age-sex percentages were then applied to the escapement in each stratum to estimate numbers of fish by age and sex. Season totals by age and sex were determined by summing age-sex class abundances across all strata, and seasonal age-sex class percentages were then obtained by dividing by total escapement. Mean length-at-age by sex was calculated using all samples. Sample sizes and dates are included for each stratum. Age is reported in the European notation, composed of two numerals separated by a decimal. The first numeral represents the number of winters the juvenile spent in freshwater excluding the first winter spent incubating in the gravel, and the second numeral is the number of winters it spent in the ocean (Groot and Margolis 1991). Therefore, the total age is one year greater than the sum of these two numerals.

WEATHER AND STREAM OBSERVATIONS

Water and air temperatures (°C) were measured each day at approximately 0800 and 1700 hours. Water temperature was determined by submerging a calibrated thermometer below the water surface until the temperature reading stabilized. Air temperature was obtained by placing the thermometer in a shaded location until the temperature reading stabilized. Temperature readings were recorded in a designated logbook, along with notations about wind direction, estimated wind speed, cloud cover, and precipitation. Daily precipitation was measured using a rain gauge calibrated in millimeters.

Daily operations included monitoring river depth with a standardized staff gage. The staff gage consisted of a metal rod driven into the stream channel with a meter stick attached. The height of the water surface, as measured from the meter stick, represented the "stage" of the river above an established datum plane. The staff gage was calibrated to the datum plane by a semi-permanent benchmark located about 6 m from the river bank and consisted of a nail driven into a tree. The

[2] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

height of the nail corresponded to stage measurements of 300 cm relative to the datum plane. River stage was measured at approximately 0800 and 1700 hours each day.

TTC HIGH SCHOOL INTERNSHIP PROGRAM

Two local area high school students were employed by the Takotna Tribal Council to assist with daily weir operations during summer months. Under the supervision of project crew members, students participated in routine passage counts, ASL sample collections, and weather and stream measurements.

RELATED FISHERIES PROJECTS

Kuskokwim River Run Reconstruction

Salmon escapement and ASL information from Takotna River weir, in combination with data from other weir projects, serve as vital annual inputs to models used to estimate Chinook and coho salmon total abundance in the Kuskokwim River drainage. These estimates further help in determination of total exploitation rates and fluctuations in annual productivity.

Assessment of Formal Escapement Goals

Annual escapement estimates from the Takotna River weir provide context as to the adequacy and quality of escapements (i.e. age and sex composition). Currently, Takotna River does not have formal salmon escapement goals but the development of these goals is a long-term process in which Takotna River is considered during each review period.

Temperature Monitoring

The Takotna River weir served as a monitoring site for the *Temperature Monitoring* project (USFWS, Office of Subsistence Management, Project No. 08-701). An OSM contractor provided the monitoring equipment for installation at the weir site. Two Hobo® Water Temp Pro V2 data loggers and one Hobo® Air Temperature R/H data loggers were installed at the beginning of the field season by switching out the previous year's temperature loggers. The water temperature loggers were anchored to the stream bed near mid-channel using a number 68 Duckbill® anchor. The air temperature logger was installed using a solar shield attached to a small spruce tree approximately 2 meters above ground level and 50 meters from the river. At the end of the field season both water temperature loggers and air temperature logger were downloaded using the provided data shuttle and left to continue monitoring temperature. The removed temperature loggers and data shuttle were returned to the contractor for data management and reporting and logger maintenance, calibration, and storage.

RESULTS

WEIR OPERATIONS

The weir was installed and operated from 27 June through 17 September in 2010, which spanned 93% of the target operational period (24 June through 20 September). Escapement passage counts were completed for all but four inoperable periods in 2010. The first inoperable period occurred from 24 June through 26 June prior to completion of the weir installation. The second inoperable period occurred on 7 July, when counts were considered partial due to the occurrence of a hole in the weir. The third inoperable period occurred from 8 to 12 September when the weir became inoperable due to high water. The final inoperable period occurred from 18 to 20 September after removal of the weir.

ESCAPEMENT MONITORING

Chinook Salmon

A total escapement of 178 Chinook salmon was estimated to have passed Takotna River weir during the target operational period in 2010. No Chinook salmon were estimated to have passed uncounted during this period even though passage was estimated with the single day method during the second inoperable period. The first Chinook salmon was observed on 30 June, daily passage peaked at 16 fish on 10 July, and the last Chinook salmon was observed on 17 September. Based on the target operational period, 50% of cumulative passage occurred on 17 July and the central 50% of the run occurred from 11 to 30 July (Table 1).

Chum Salmon

A total escapement of 4,062 chum salmon was estimated to have passed Takotna River weir during the target operational period in 2010. Estimates for missed passage accounted for 62 fish, or 1.5% of the total. Estimates were created with the single day method during the second inoperable period. The first chum salmon was observed on 29 June, daily passage peaked at 215 fish on 17 July, and the last chum salmon was observed on 3 September. Based on the target operational period, 50% of cumulative passage occurred on 18 July and the central 50% of the passage occurred from 11 to 24 July (Table 1).

Coho Salmon

A total escapement of 3,217 coho salmon was estimated to have passed Takotna River weir during the target operational period in 2010. Estimates for missed passage accounted for 336 fish, or 10.4% of the total. Estimates were created with the linear method during the third inoperable period, and with the exponential method, fitted to the exponential function ($y=71.248e^{-0.129i}$) from the preceding 5 days' counts, during the last inoperable period. The first coho salmon was observed on 9 August, daily passage peaked at 309 fish on 31 August, and the last coho salmon was observed on 17 September (the last day of operation). Based on the target operational period, 50% of cumulative passage occurred on 1 September and the central 50% of the run occurred from 27 August to 7 September (Table 1).

Sockeye Salmon

A total escapement of 8 sockeye salmon was estimated to have passed Takotna River weir during the target operational period in 2010 (Table 1). No sockeye salmon were estimated to have passed uncounted during this period. The first sockeye salmon was observed on 13 July and the last was observed on 11 September.

Other Species

It is likely that small fish such as pink salmon *O. gorbuscha* and non-salmon species pass freely between weir pickets. Counts of these fish are therefore not considered a census of passage, but are reported here as "species detected" information. In 2010, no pink salmon were observed passing upstream of the Takotna River. Other species observed passing upstream of Takotna River weir in 2010 included 737 longnose suckers, 37 Arctic grayling *Thymallus arcticus*, 35 whitefish *Coregonus* spp. and 11 northern pike (Appendix A1). Passage missed during inoperable periods at the weir was not estimated for these species.

Carcass Counts

A total of 258 salmon carcasses were recovered at Takotna River weir in 2010 (Appendix B1). Chum salmon were the most numerous (241), followed by Chinook (14) and coho (3) salmon. Males comprised 83% of chum and 86% of Chinook salmon carcasses. Non-salmon carcasses consisted of longnose sucker (228), whitefish (27), and northern pike (9).

AGE, SEX, AND LENGTH COMPOSITION

Chinook Salmon

Samples were collected from 93 Chinook salmon between 3 July and 14 August. Of those, age was determined for 76 fish (82% of the total sample), or 43% of Chinook salmon escapement. The escapement was partitioned into 3 temporal strata based on sampling dates, with sample sizes of 28, 38, and 10 in the first, second, and third strata, respectively (Table 2). The sample results were not applied to escapement.

The sample comprised 5 age classes. Within the sample, age-1.2 was the most abundant age class (69.1%), followed by age-1.3 (16.0%), age-1.4 (10.8%), age-1.1 (3.0%) and -2.2 (1.2%). Females comprised 14.3% of the total. Age-1.2 and -1.3 fish were predominately males, while age-1.4 fish were predominately females.

Sampled fish ranged between 374 mm and 910 mm in length and sample sizes ranged from 1 to 50 fish among the predominant age-sex categories. Mean length of female Chinook salmon was 858 mm at age-1.4. Mean lengths of male age-1.2, -1.3, and -1.4 fish were 538, 678, and 778 mm, respectively. Age-1.4 female Chinook salmon were consistently larger than age-1.4 males.

Chum Salmon

Samples were collected from 1,055 chum salmon between 2 July and 18 August. Of those, age was determined for 1,023 fish (97% of the total sample), representing 25% of chum salmon escapement. The escapement was partitioned into 5 temporal strata based on sampling dates, with 271, 220, 159, 214, and 159 samples in each stratum. Sample size and distribution resulted in 95% confidence intervals for age composition no wider than ±2.1% (Table 3).

The sample was composed of 4 age classes. As applied to escapement, age-0.3 was the most abundant age class (79.6%), followed by age-0.2 (10.4%), age-0.4 (9.6%), and age-0.5 (0.5%). Females composed 55.0% of the total.

Sampled fish ranged between 483 mm and 664 mm in length and sample sizes ranged from 2 to 454 fish among the predominant age-sex categories. Mean lengths of female chum salmon were 531 mm at age-0.3, 528 mm at age-0.2, and 541 mm at age-0.4. Mean lengths of male age-0.3, -0.2 and -0.4 fish were 561, 538, and 584 mm, respectively. Male chum salmon were consistently larger at age than females.

Coho Salmon

Samples were collected from 600 coho salmon between 11 August and 17 September. Of those, age was determined for 517 fish (86% of the total sample), representing 16% of annual coho salmon escapement. The escapement was partitioned into 3 temporal strata based on sampling dates, with 183, 139 and 195 samples in each stratum, respectively. Sample size and distribution resulted in 95% confidence intervals for age composition no wider than ±2.1% (Table 4).

The sample comprised 3 age classes. As applied to escapement, coho salmon were predominately age-2.1 (92.9%), followed by age-1.1 (5.4%), and age-3.1 (1.7%). Females comprised 53.6% of the total.

Sampled fish ranged between 405 mm and 775 mm in length and sample sizes ranged from 3 to 253 fish among the predominant age-sex categories (Table 4). Mean lengths of female coho salmon were 540 mm at age-2.1, and 536 mm at age-1.1. Mean lengths of male age-2.1 and -1.1 were 529 mm and 518 mm, respectively. Female coho salmon were consistently larger at age than males (Table 4).

WEATHER AND STREAM OBSERVATIONS

A total of 164 complete weather and stream observations were recorded between 28 June and 17 September, 2010 (Appendix C1). Based on twice-daily thermometer observations, water temperature at the weir ranged from 6°C to 19°C, with an average of 11.7°C. A total of 167.5 mm of precipitation was recorded throughout the season. River stage ranged from 47 cm to 106 cm, with an average of 66 cm.

TTC HIGH SCHOOL INTERNSHIP PROGRAM

Two local area high school students participated in the TTC Internship Program in 2010. Interns assisted crew members in daily counting, sampling, weir maintenance, and weather observations throughout the summer. Interns worked 15 to 20 hours per week during July and August, and 15 hours per week through September.

RELATED FISHERIES PROJECTS

Temperature Monitoring

Two Hobo® Water Temp Pro V2 data loggers deployed in 2009 were not recovered at the beginning of the 2010 field season. Attempts to locate the prior season's in-river data loggers delayed the deployment 2010 season's water temperature monitors until the end of field season. Consequently, no water temperature data was captured by the Hobo® monitors during the 2010 field season. Results for temperature monitoring will be reported under USFWS, Office of Subsistence Management, Project No. 08-701.

DISCUSSION

OPERATIONS

Logistical constraints and high water affected operation of Takotna River weir throughout the season. Above average water levels in August and September contributed to the last two inoperable periods (Figure 3). Nonetheless, escapement was successfully determined, as missed passage accounted for less than 20% of estimated annual escapement for each target species.

ESCAPEMENTS

Chinook Salmon

Escapement in 2010 was the lowest reported at Takotna River weir and was only 43% of the historical median (Figure 4). Chinook salmon escapements were the lowest recorded at all Kuskokwim River weirs except for Kogrukluk River, where the low end of the escapement goal range was achieved (Figure 5). Chinook passage at the weir began the same day as the historical median but was 11 days longer in duration, making it the most protracted run timing observed at this location (Figure 6).

Years of low abundance—like 2010—present opportunity for studying the resilience of distinct tributary stocks within the Kuskokwim River. Perspectives provided by these projects, like Takotna River weir, may be used in the future to examine differential exploitation of stocks by commercial and subsistence fisheries in the Lower River. It is intended that by continuing collection of annual run data, along with other data sources, we may be able to design management strategies that account for the specific needs of distinct tributary stocks within the Kuskokwim drainage aggregate. Without widely distributed projects like the Takotna River weir, management would only be focused on the sum total of fish returning to the Kuskokwim drainage in general, therefore failing to address the needs of stock distribution throughout.

As in years past, collecting the optimal ASL sample size for Takotna River Chinook salmon was problematic, given the small population. The need to collect samples was weighed against the need to allow efficient passage through the weir. The 2010 sample (n=76) fell below the sample design size (n'=92, N=178) for 10 age-sex categories, yet the sample represented more than a third of the total population.

Salmon have been counted by sex at Takotna River weir since 2005, allowing for comparison between visual and ASL sex compositions to assess possible biases. Although determining sex from passing fish is less definitive than from ASL samples, counts by sex are considered fairly accurate given the distinct sexual dimorphism that develops by the time migrating salmon reach the Takotna River weir. In previous seasons similar female sex ratios have been estimated in the passage count and ASL sample; however in 2010, a large disparity was observed between these two estimates (Figure 7). Further investigation revealed possible bias in the Chinook salmon ASL sample. The crew leader reported nearly all ASL samples were collected in the morning, prompting examination of the field logbook to compare passage of male and female Chinook salmon by time of day (Figure 8). The proportion of females was considerably lower in the morning, when most of the samples were collected, than in the afternoon or evening. This resulting male bias also produced an age bias, given that male Chinook salmon are predominantly younger than females. Therefore, the sample was not applied to the population.

It is not clear how samples were collected in prior years with respect to time of day at Takotna River weir. In 2010, however, the trap was usually left set overnight to collect enough fish for sampling the following morning. This practice should not be continued in future years. Bias should be avoided by sampling at various times of the day instead of only one time period each day.

Video monitoring has been shown to improve accuracy of weir counts and species identification by reducing the haste and adverse conditions that influence visual enumeration of salmon passing upstream (Anderson et al. 2006). By providing a clearer, lateral view of each passing fish, video monitoring may be a feasible technique to further increase accuracy of visual sex identification. It is suggested that future studies at Takotna River weir include video monitoring to assist in, and investigate possible observational bias associated with, sex identification.

Chum Salmon

Escapement in 2010 was 17% lower than the historical median (Figure 4). Chum passage at the weir began one day later and was six days longer in duration compared to the historical median (Figure 6).

ASL composition of chum salmon was estimated successfully (Table 3). Takotna River chum salmon returned primarily as age-0.3 and -0.4 fish (Figure 9), which is common among Kuskokwim Area stocks (Molyneaux et al. 2010). Historically, age-0.3 fish have tended to outnumber age-0.4 fish at Takotna River weir, as they did in 2010.

Coho Salmon

Escapement in 2010 was 6% above the historical median (Figure 4). Coho passage at the weir was three days later and seven days longer in duration than the historical median (Figure 6).

ASL composition of coho salmon was estimated successfully (Table 4). In 2010, similar to historical observations, Takotna River coho salmon returned almost entirely as age-2.1 fish (Figure 7). Abundance of age-1.1 fish was greater than age-3.1 fish, in contrast to the historical median abundance for those age classes (Figure 9).

TTC High School Internship Program

The Takotna River weir has hosted internships for local area high school students annually since 2000. These internships serve to foster student career interest and improve local understanding of fisheries management and research activities. Past interns have been employed as technicians at the weir and taken positions with ADF&G in Bethel and with Kuskokwim Native Association in Aniak. The TTC technician at the weir in 2010 was a former intern. These internships benefit both students and the weir project. Students gain exposure to fisheries research and management, while the weir project gains a much needed level of community involvement and support. The authors look forward to continued involvement with this program.

CONCLUSIONS

- Daily and total annual escapements were successfully determined for each of the target species at Takotna River weir.
- Estimates were calculated for four inoperable periods (10 days total) within the target operational period. Estimates accounted for 0% of Chinook, 1.5% of chum, and 10.4% of coho salmon total annual escapements.
- Chinook salmon escapement was low throughout the Kuskokwim River, and was the lowest reported at Takotna River weir. Chum salmon escapement was 17% below, and coho salmon escapement 6% above, the historical median.
- Chinook salmon ASL composition was not estimated successfully due to sampling bias. Chum and coho salmon ASL composition was estimated successfully.
- Coho salmon age-1.1 abundance was greater than age-1.3 which is contrary of the historical median.

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TABLES AND FIGURES

Table 1.–Daily, cumulative, and cumulative percent passage of Chinook, sockeye, chum, and coho salmon at Takotna River weir, 2010.

Date	Chinook Salmon			Sockeye Salmon			Chum Salmon			Coho Salmon		
	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%
24 Jun [a]	0	0	0	0	0	0	0	0	0	0	0	0
25 Jun [a]	0	0	0	0	0	0	0	0	0	0	0	0
26 Jun [a]	0	0	0	0	0	0	0	0	0	0	0	0
27 Jun	0	0	0	0	0	0	0	0	0	0	0	0
28 Jun	0	0	0	0	0	0	0	0	0	0	0	0
29 Jun	0	0	0	0	0	0	4	4	0	0	0	0
30 Jun	3	3	2	0	0	0	10	14	0	0	0	0
1 Jul	4	7	4	0	0	0	27	41	1	0	0	0
2 Jul	0	7	4	0	0	0	28	69	2	0	0	0
3 Jul	1	8	4	0	0	0	31	100	2	0	0	0
4 Jul	5	13	7	0	0	0	76	176	4	0	0	0
5 Jul	0	13	7	0	0	0	130	306	8	0	0	0
6 Jul	4	17	10	0	0	0	86	392	10	0	0	0
7 Jul [b]	2	19	11	0	0	0	120	512	13	0	0	0
8 Jul	4	23	13	0	0	0	132	644	16	0	0	0
9 Jul	1	24	13	0	0	0	132	776	19	0	0	0
10 Jul	16	40	22	0	0	0	158	934	23	0	0	0
11 Jul	12	52	29	0	0	0	86	1,020	25	0	0	0
12 Jul	7	59	33	0	0	0	170	1,190	29	0	0	0
13 Jul	7	66	37	1	1	13	132	1,322	33	0	0	0
14 Jul	14	80	45	0	1	13	87	1,409	35	0	0	0
15 Jul	2	82	46	0	1	13	151	1,560	38	0	0	0
16 Jul	1	83	47	0	1	13	138	1,698	42	0	0	0
17 Jul	9	92	52	0	1	13	215	1,913	47	0	0	0
18 Jul	3	95	53	0	1	13	190	2,103	52	0	0	0
19 Jul	5	100	56	0	1	13	166	2,269	56	0	0	0
20 Jul	0	100	56	0	1	13	191	2,460	61	0	0	0
21 Jul	3	103	58	0	1	13	209	2,669	66	0	0	0
22 Jul	2	105	59	1	2	25	121	2,790	69	0	0	0
23 Jul	3	108	61	0	2	25	103	2,893	71	0	0	0
24 Jul	0	108	61	0	2	25	140	3,033	75	0	0	0
25 Jul	4	112	63	0	2	25	92	3,125	77	0	0	0
26 Jul	5	117	66	0	2	25	162	3,287	81	0	0	0
27 Jul	6	123	69	0	2	25	114	3,401	84	0	0	0
28 Jul	4	127	71	0	2	25	100	3,501	86	0	0	0
29 Jul	3	130	73	0	2	25	89	3,590	88	0	0	0
30 Jul	10	140	79	0	2	25	68	3,658	90	0	0	0
31 Jul	8	148	83	1	3	38	51	3,709	91	0	0	0
1 Aug	5	153	86	0	3	38	52	3,761	93	0	0	0
2 Aug	0	153	86	1	4	50	50	3,811	94	0	0	0
3 Aug	2	155	87	0	4	50	51	3,862	95	0	0	0
4 Aug	8	163	92	0	4	50	36	3,898	96	0	0	0
5 Aug	1	164	92	0	4	50	29	3,927	97	0	0	0
6 Aug	1	165	93	0	4	50	22	3,949	97	0	0	0
7 Aug	3	168	94	0	4	50	14	3,963	98	0	0	0
8 Aug	0	168	94	0	4	50	26	3,989	98	0	0	0
9 Aug	0	168	94	1	5	63	9	3,998	98	2	2	0

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Table 1.–Page 2 of 2.

Date	Chinook Salmon			Sockeye Salmon			Chum Salmon			Coho Salmon		
	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%
10 Aug	0	168	94	0	5	63	7	4,005	99	3	5	0
11 Aug	0	168	94	0	5	63	14	4,019	99	1	6	0
12 Aug	1	169	95	0	5	63	10	4,029	99	6	12	0
13 Aug	2	171	96	0	5	63	8	4,037	99	12	24	1
14 Aug	2	173	97	0	5	63	3	4,040	99	12	36	1
15 Aug	0	173	97	0	5	63	2	4,042	100	3	39	1
16 Aug	0	173	97	0	5	63	0	4,042	100	21	60	2
17 Aug	0	173	97	0	5	63	4	4,046	100	44	104	3
18 Aug	0	173	97	0	5	63	2	4,048	100	47	151	5
19 Aug	0	173	97	0	5	63	0	4,048	100	37	188	6
20 Aug	0	173	97	0	5	63	4	4,052	100	32	220	7
21 Aug	0	173	97	0	5	63	0	4,052	100	55	275	9
22 Aug	0	173	97	0	5	63	2	4,054	100	60	335	10
23 Aug	0	173	97	0	5	63	0	4,054	100	149	484	15
24 Aug	0	173	97	0	5	63	3	4,057	100	95	579	18
25 Aug	0	173	97	0	5	63	1	4,058	100	73	652	20
26 Aug	0	173	97	0	5	63	1	4,059	100	101	753	23
27 Aug	1	174	98	0	5	63	0	4,059	100	102	855	27
28 Aug	0	174	98	1	6	75	2	4,061	100	71	926	29
29 Aug	0	174	98	0	6	75	0	4,061	100	102	1,028	32
30 Aug	1	175	98	0	6	75	0	4,061	100	89	1,117	35
31 Aug	1	176	99	0	6	75	0	4,061	100	309	1,426	44
1 Sep	0	176	99	0	6	75	0	4,061	100	174	1,600	50
2 Sep	1	177	99	0	6	75	0	4,061	100	142	1,742	54
3 Sep	0	177	99	1	7	88	1	4,062	100	176	1,918	60
4 Sep	0	177	99	0	7	88	0	4,062	100	207	2,125	66
5 Sep	0	177	99	0	7	88	0	4,062	100	192	2,317	72
6 Sep	0	177	99	0	7	88	0	4,062	100	73	2,390	74
7 Sep	0	177	99	0	7	88	0	4,062	100	111	2,501	78
8 Sep [b]	0	177	99	0	7	88	0	4,062	100	87	2,588	80
9 Sep [b]	0	177	99	0	7	88	0	4,062	100	82	2,670	83
10 Sep [a]	0	177	99	0	7	88	0	4,062	100	76	2,746	85
11 Sep [b]	0	177	99	1	8	100	0	4,062	100	71	2,817	88
12 Sep [b]	0	177	99	0	8	100	0	4,062	100	66	2,883	90
13 Sep	0	177	99	0	8	100	0	4,062	100	59	2,942	91
14 Sep	0	177	99	0	8	100	0	4,062	100	62	3,004	93
15 Sep	0	177	99	0	8	100	0	4,062	100	44	3,048	95
16 Sep	0	177	99	0	8	100	0	4,062	100	46	3,094	96
17 Sep	1	178	100	0	8	100	0	4,062	100	36	3,130	97
18 Sep [a]	0	178	100	0	8	100	0	4,062	100	33	3,163	98
19 Sep [a]	0	178	100	0	8	100	0	4,062	100	29	3,192	99
20 Sep [a]	0	178	100	0	8	100	0	4,062	100	25	3,217	100

[a] The weir was not operational; daily passage was estimated.

[b] Partial day count, passage was estimated.

Table 2.–Age and sex composition with mean length (mm) of Chinook salmon at Takotna River weir in 2010 based on escapement samples collected with a live trap.

			Brood Year (Age Class)												
			2007		2006		2005		2004		2003		2002		
Sample Dates	Sample		(0.2)	(1.1)	(1.2)	(2.1)	(1.3)	(2.2)	(1.4)	(2.3)	(1.5)	(2.4)	(1.6)	(2.5)	Total
(Stratum Dates)	Size		N %	N %	N %	N %	N %	N %	N %	N %	N %	N %	N %	N %	N %
7/03-04, 7/06-12	28	Male	0.0	0.0	67.9	0.0	14.3	3.6	0.0	0.0	0.0	0.0	0.0	0.0	85.7
(6/24-7/12)		Female	0.0	0.0	10.7	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	14.3
		Subtotal[a]	0.0	0.0	78.6	0.0	14.3	3.6	3.6	0.0	0.0	0.0	0.0	0.0	100.0
		Male Mean Length	-	-	523	-	722	496	-	-	-	-	-	-	
		SE	-	-	7	-	29	-	-	-	-	-	-	-	
		Range	-	-	455-592	-	677-804	-	-	-	-	-	-	-	
		n	-	-	19	-	4	1	-	-	-	-	-	-	
		Female Mean Length	-	-	541	-	-	-	850	-	-	-	-	-	
		SE	-	-	7	-	-	-	-	-	-	-	-	-	
		Range	-	-	527-549	-	-	-	-	-	-	-	-	-	
		n	-	-	3	-	-	-	1	-	-	-	-	-	
7/13-15, 7/17-19,	38	Male	0.0	0.0	65.8	0.0	13.2	0.0	5.3	0.0	0.0	0.0	0.0	0.0	84.2
7/21-23, 7/25		Female	0.0	2.6	0.0	0.0	2.6	0.0	10.5	0.0	0.0	0.0	0.0	0.0	15.8
(7/13-7/25)		Subtotal[a]	0.0	2.6	65.8	0.0	15.8	0.0	15.8	0.0	0.0	0.0	0.0	0.0	100.0
		Male Mean Length	-	-	554	-	669	-	778	-	-	-	-	-	
		SE	-	-	9	-	12	-	28	-	-	-	-	-	
		Range	-	-	468-633	-	625-691	-	750-805	-	-	-	-	-	
		n	-	-	25	-	5	-	2	-	-	-	-	-	
		Female Mean Length	-	387	-	-	594	-	845	-	-	-	-	-	
		SE	-	-	-	-	-	-	23	-	-	-	-	-	
		Range	-	-	-	-	-	-	801-910	-	-	-	-	-	
		n	-	1	-	-	1	-	4	-	-	-	-	-	

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Table 2.–Page 2 of 2.

			Brood Year (Age Class)																									
			2007				2006				2005				2004				2003				2002					
Sample Dates	Sample		(0.2)		(1.1)		(1.2)		(2.1)		(1.3)		(2.2)		(1.4)		(2.3)		(1.5)		(2.4)		(1.6)		(2.5)		Total	
(Stratum Dates)	Size		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
8/01, 8/03-4,	10	Male		0.0		10.0		60.0		0.0		20.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		90.0
8/07, 8/12-8/14		Female		0.0		0.0		0.0		0.0		0.0		0.0		10.0		0.0		0.0		0.0		0.0		0.0		10.0
(8/01-9/17)		Subtotal[a]		0.0		10.0		60.0		0.0		20.0		0.0		10.0		0.0		0.0		0.0		0.0		0.0		100.0
		Male Mean Length	-		374		522		-		619		-		-		-		-		-		-		-			
		SE	-		-		19		-		27		-		-		-		-		-		-		-			
		Range	-		-		476-592		-		592-646		-		-		-		-		-		-		-			
		n	-		1		6		-		2		-		-		-		-		-		-		-			
		Female Mean Length	-		-		-		-		-		-		910		-		-		-		-		-			
		SE	-		-		-		-		-		-		-		-		-		-		-		-			
		Range	-		-		-		-		-		-		-		-		-		-		-		-			
		n	-		-		-		-		-		-		1		-		-		-		-		-			
	76	Male																										
Season[b]		Female																										
		Total[a]																										
		Male Mean Length	-		-		-		-		-		-		-		-		-		-		-		-			
		SE	-		-		-		-		-		-		-		-		-		-		-		-			
		Range	-		-		-		-		-		-		-		-		-		-		-		-			
		n	-		-		-		-		-		-		-		-		-		-		-		-			
		Female Mean Length	-		-		-		-		-		-		-		-		-		-		-		-			
		SE	-		-		-		-		-		-		-		-		-		-		-		-			
		Range	-		-		-		-		-		-		-		-		-		-		-		-			
		n	-		-		-		-		-		-		-		-		-		-		-		-			

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; however these numbers were not calculated in 2010 due to sampling bias.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum. “Season” mean lengths are weighted by the escapement in each stratum. “Season” number of fish and percentages were not calculated in 2010 due to sampling bias.

Table 3.–Age and sex composition with mean length (mm) of chum salmon at Takotna River weir in 2010 based on escapement samples collected with a live trap.

			Brood Year (Age Class)											
			2007		2006		2005		2004		2003			
Sample Dates	Sample		(0.2)		(0.3)		(0.4)		(0.5)		(0.6)		Total	
(Stratum Dates)	Size		N	%	N	%	N	%	N	%	N	%	N	%
7/02- 7/09	271	Male	37	4.8	297	38.2	74	9.6	3	0.4	0	0.0	411	52.9
(6/24-7/09)		Female	40	5.1	308	39.7	17	2.2	0	0.0	0	0.0	365	47.1
		Subtotal[a]	77	9.9	605	77.9	91	11.8	3	0.4	0	0.0	776	100.0
		Male Mean Length	565		573		609		588		-			
		SE	8		3		6		-		-			
		Range	515-617		504-664		554-664		588-588		-			
		n	13		104		26		1		-			
		Female Mean Length	545		545		538		-		-			
		SE	3		2		6		-		-			
		Range	520-571		495-587		516-549		-		-			
		n	14		108		5		-		-			
7/10-7/16	220	Male	21	2.3	348	37.7	54	5.9	4	0.5	0	0.0	427	46.4
(7/10-7/16)		Female	101	10.9	365	39.5	29	3.2	0	0.0	0	0.0	495	53.6
		Subtotal[a]	122	13.2	712	77.3	84	9.1	4	0.5	0	0.0	922	100.0
		Male Mean Length	533		563		594		532		-			
		SE	5		3		8		-		-			
		Range	514-545		509-616		535-644		532-532		-			
		n	5		83		13		1		-			
		Female Mean Length	534		534		551		-		-			
		SE	5		3		9		-		-			
		Range	508-592		482-622		524-592		-		-			
		n	24		87		7		-		-			

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Table 3.–Page 2 of 3.

Sample Dates (Stratum Dates)	Sample Size		Brood Year (Age Class) 2007 (0.2) N	%	2006 (0.3) N	%	2005 (0.4) N	%	2004 (0.5) N	%	2003 (0.6) N	%	Total N	%
7/17-7/20 (7/17-7-20)	159	Male	34	4.4	326	42.8	67	8.8	0	0.0	0	0.0	427	56.0
		Female	53	6.9	259	34.0	19	2.5	5	0.6	0	0.0	335	44.0
		Subtotal[a]	86	11.3	585	76.7	86	11.3	5	0.6	0	0.0	762	100.0
		Male Mean Length	540		559		569		-		-			
		SE	13		3		7		-		-			
		Range	499-575		500-615		524-612		-		-			
		n	7		68		14		-		-			
		Female Mean Length	531		529		538		536		-			
		SE	7		4		20		-		-			
		Range	497-576		455-587		500-584		536-536		-			
		n	11		54		4		1		-			
7/21-7/26 (7/21-7/26)	214	Male	39	4.7	243	29.4	39	4.7	4	0.5	0	0.0	325	39.3
		Female	54	6.5	410	49.5	35	4.2	4	0.5	0	0.0	502	60.7
		Subtotal[a]	93	11.2	653	79.0	73	8.9	8	0.9	0	0.0	827	100.0
		Male Mean Length	527		553		582		584		-			
		SE	7		3		12		-		-			
		Range	494-563		495-600		504-633		584-584		-			
		n	10		63		10		1		-			
		Female Mean Length	522		528		543		555		-			
		SE	6		2		8		-		-			
		Range	483-553		470-597		500-575		555-555		-			
		n	14		106		9		1		-			
8/01-8/08, 8/10-8/15, 8/17,	159	Male	19	2.5	195	25.2	24	3.1	0	0.0	0	0.0	239	30.8
8/18		Female	24	3.1	483	62.3	29	3.8	0	0.0	0	0.0	536	69.2
(7/27-9/20)		Subtotal[a]	44	5.7	678	87.4	54	6.9	0	0.0	0	0.0	775	100.0

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Table 3.–Page 3 of 3.

Sample Dates (Stratum Dates)	Sample Size		2007 (0.2) N	%	2006 (0.3) N	%	2005 (0.4) N	%	2004 (0.5) N	%	2003 (0.6) N	%	Total N	%
		Male Mean Length	524		556		564		-		-			
		SE	6		5		13		-		-			
		Range	508-537		508-644		525-597		-		-			
		n	4		40		5		-		-			
		Female Mean Length	506		518		535		-		-			
		SE	10		3		18		-		-			
		Range	483-535		472-599		471-587		-		-			
		n	5		99		6		-		-			
Season[b]	1,023	Male	150	3.7	1,409	34.7	259	6.4	11	0.3	0	0.0	1,828	45.0
		Female	272	6.7	1,824	44.9	130	3.2	9	0.2	0	0.0	2,234	55.0
		Total[a]	421	10.4	3,233	79.6	388	9.6	20	0.5	0	0.0	4,062	100.0
		95% C.I. (%)	(±1.62)		(±2.14)		(±1.58)		(±0.38)		-			
		Male Mean Length	538		561		584		566		-			
		SE[c]	4		1		4		-		-			
		Range	494-617		495-664		504-664		532-588		-			
		n	39		358		68		3		-			
		Female Mean Length	528		531		541		546		-			
		SE[c]	3		1		6		-		-			
		Range	483-592		455-622		471-592		536-555		-			
		n	68		454		31		2		-			

Brood Year (Age Class)

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum. "Season" mean lengths are weighted by the escapement in each stratum.

[c] Standard error was not calculated for small samples.

Table 4.–Age and sex composition with mean length (mm) of coho salmon at Takotna River weir in 2010 based on escapement samples collected with a live trap.

			Brood Year (Age Class)							
			2007		2006		2005			
Sample Dates	Sample		(1.1)		(2.1)		(3.1)		Total	
(Stratum Dates)	Size		N	%	N	%	N	%	N	%
8/11-8/19, 8/21-8/23, 8/27, 8/28 (6/24-8/28)	183	Male	56	6.0	466	50.3	0	0.0	521	56.3
		Female	40	4.4	364	39.3	0	0.0	405	43.7
		Subtotal[a]	96	10.4	830	89.6	0	0.0	926	100.0
		Male Mean Length	508		530		-			
		SE	14		5		-			
		Range	412-591		405-775		-			
		n	11		92		-			
		Female Mean Length	545		546		-			
		SE	14		4		-			
		Range	496-600		440-596		-			
		n	8		72		-			
8/29-9/04 (8/29-9/04)	139	Male	9	0.7	466	38.8	9	0.7	483	40.3
		Female	9	0.7	690	57.6	17	1.4	716	59.7
		Subtotal[a]	17	1.4	1156	96.4	26	2.2	1199	100.0
		Male Mean Length	515		523		440			
		SE	-		7		-			
		Range	-		432-611		-			
		n	1		54		1			
		Female Mean Length	550		535		543			
		SE	-		4		17			
		Range	-		411-605		526-560			
		n	1		80		2			

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Table 4.–Page 2 of 2.

Sample Dates (Stratum Dates)	Sample Size		Brood Year (Age Class) 2007 (1.1) N	%	2006 (2.1) N	%	2005 (3.1) N	%	Total N	%
9/05, 9/07, 9/10-9/17	195	Male	28	2.6	437	40.0	22	2.1	487	44.6
		Female	34	3.1	566	51.8	6	0.5	605	55.4
(9/05-9/20)		Subtotal[a]	62	5.6	1002	91.8	28	2.6	1092	100.0
		Male Mean Length	529		536		498			
		SE	29		6		31			
		Range	455-609		440-622		448-587			
		n	5		78		4			
		Female Mean Length	514		541		545			
		SE	10		4		-			
		Range	492-551		434-634		-			
		n	6		101		1			
Season[b]	517	Male	92	2.9	1,368	42.5	31	1.0	1,491	46.4
		Female	83	2.6	1,620	50.4	23	0.7	1,726	53.6
		Total[a]	175	5.4	2,988	92.9	54	1.7	3,217	100.0
		95% C.I. (%)		(±1.89)		(±2.11)		(±0.97)		
		Male Mean Length	518		529		467			
		SE	17		3		31			
		Range	412-609		405-775		440-587			
		n	17		224		5			
		Female Mean Length	536		540		544			
		SE	8		2		17			
		Range	492-600		411-634		526-560			
		n	15		253		3			

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum. “Season” mean lengths are weighted by the escapement in each stratum.

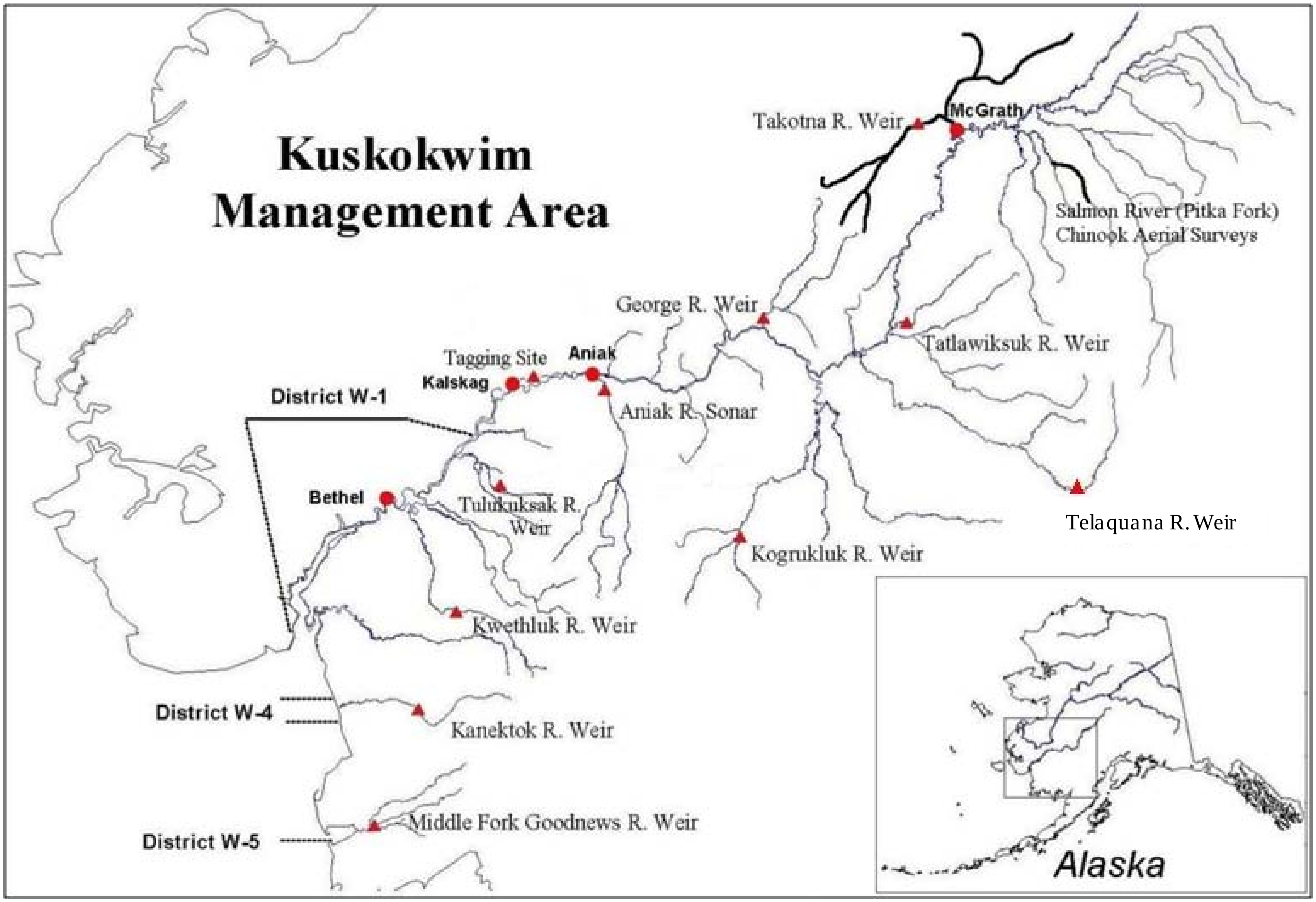


Figure 1.–Kuskokwim Area salmon management districts and escapement monitoring projects with emphasis on the Takotna River.

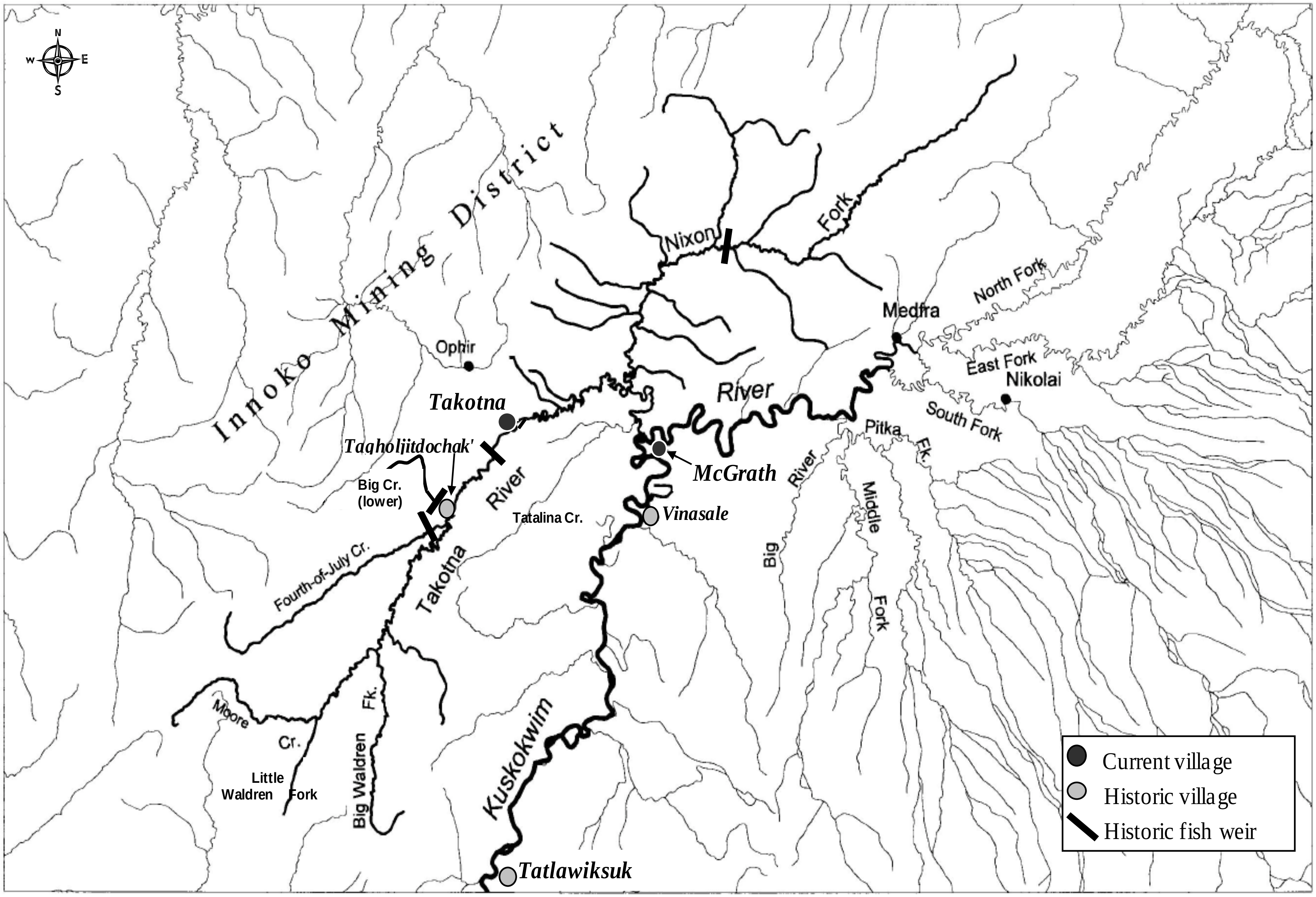


Figure 2.–Takotna River drainage and location of historic native communities and fish weirs.

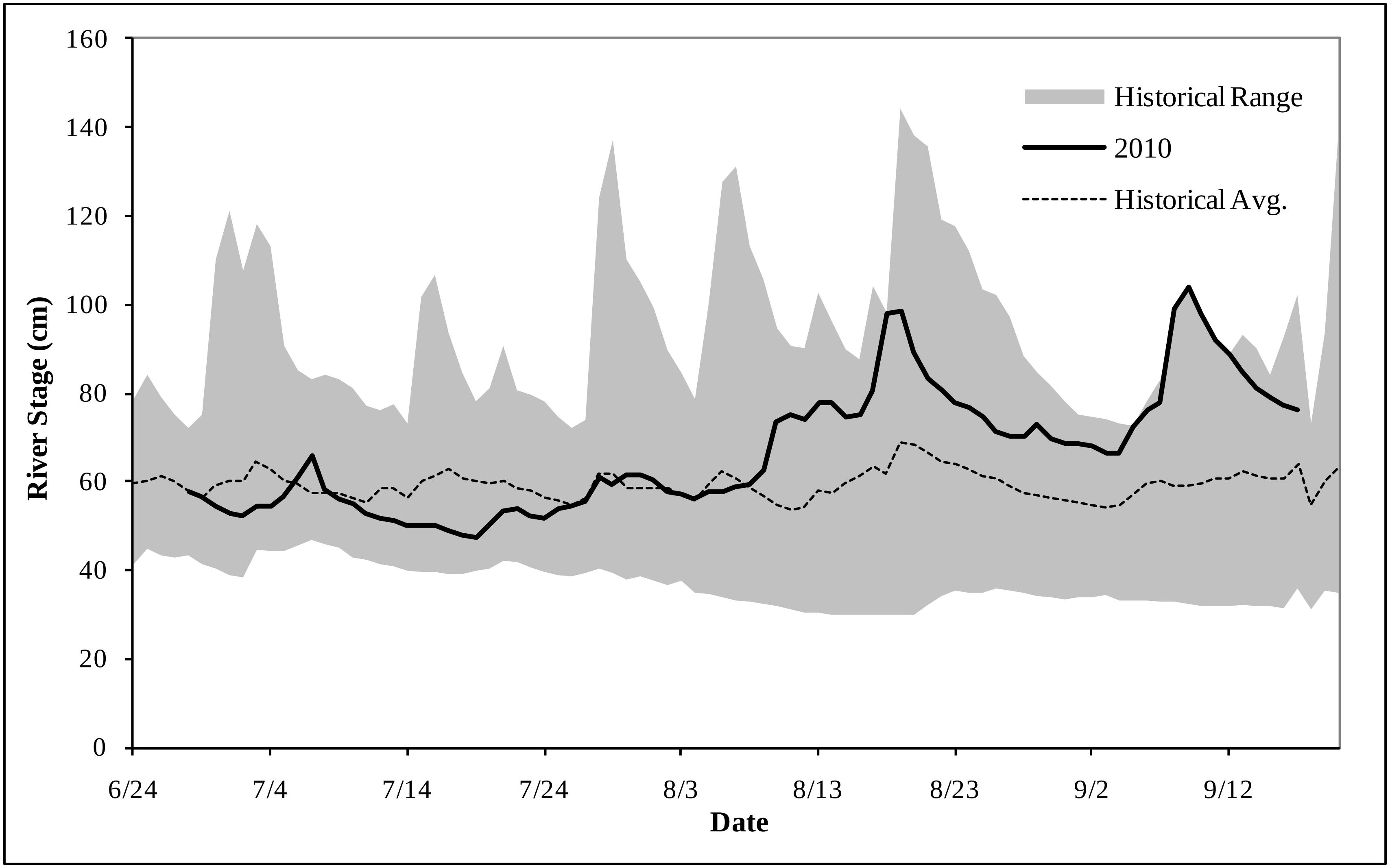


Figure 3.–Daily water level at Takotna River weir in 2010 relative to its historical average and range since 2000.

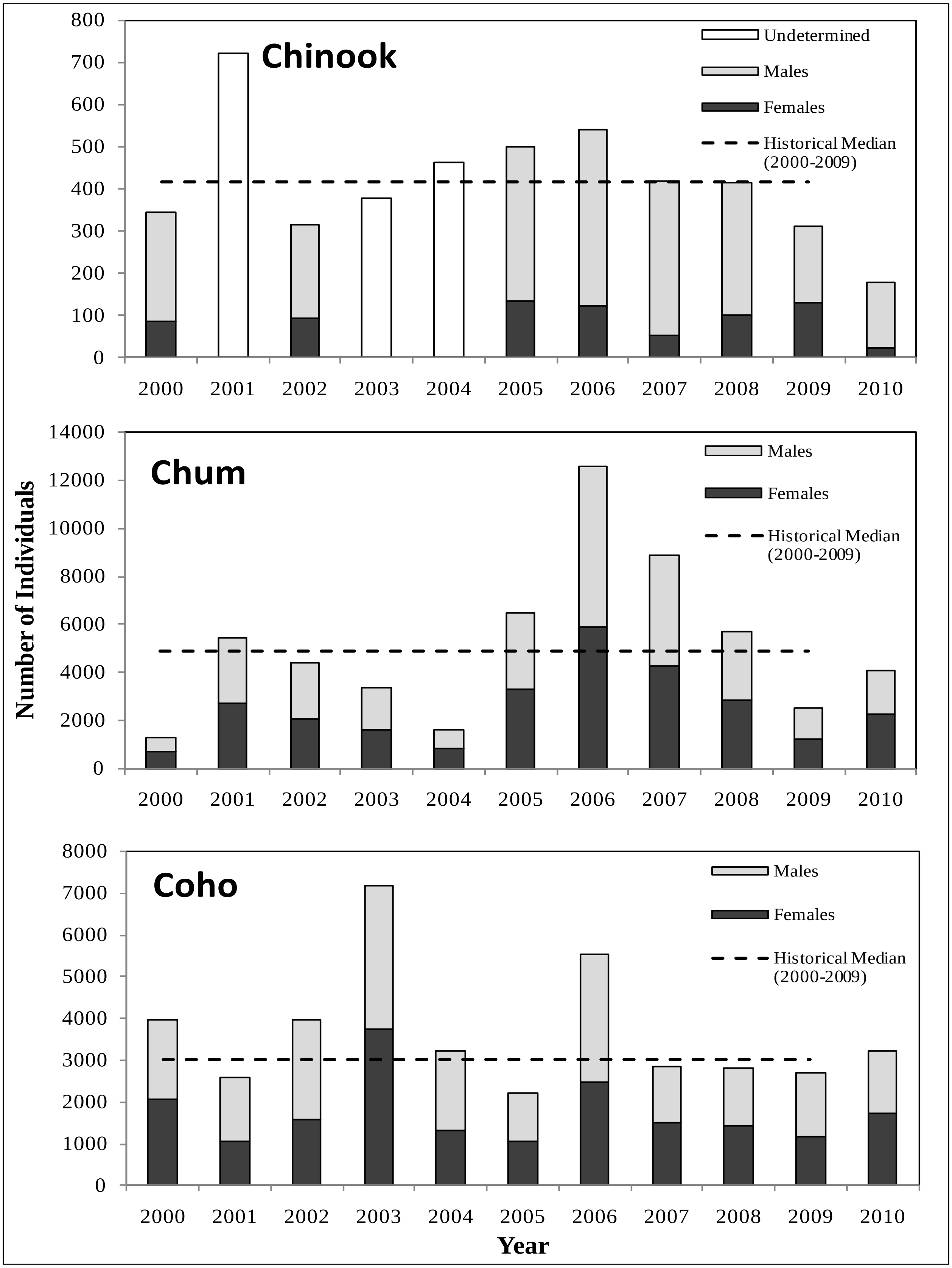
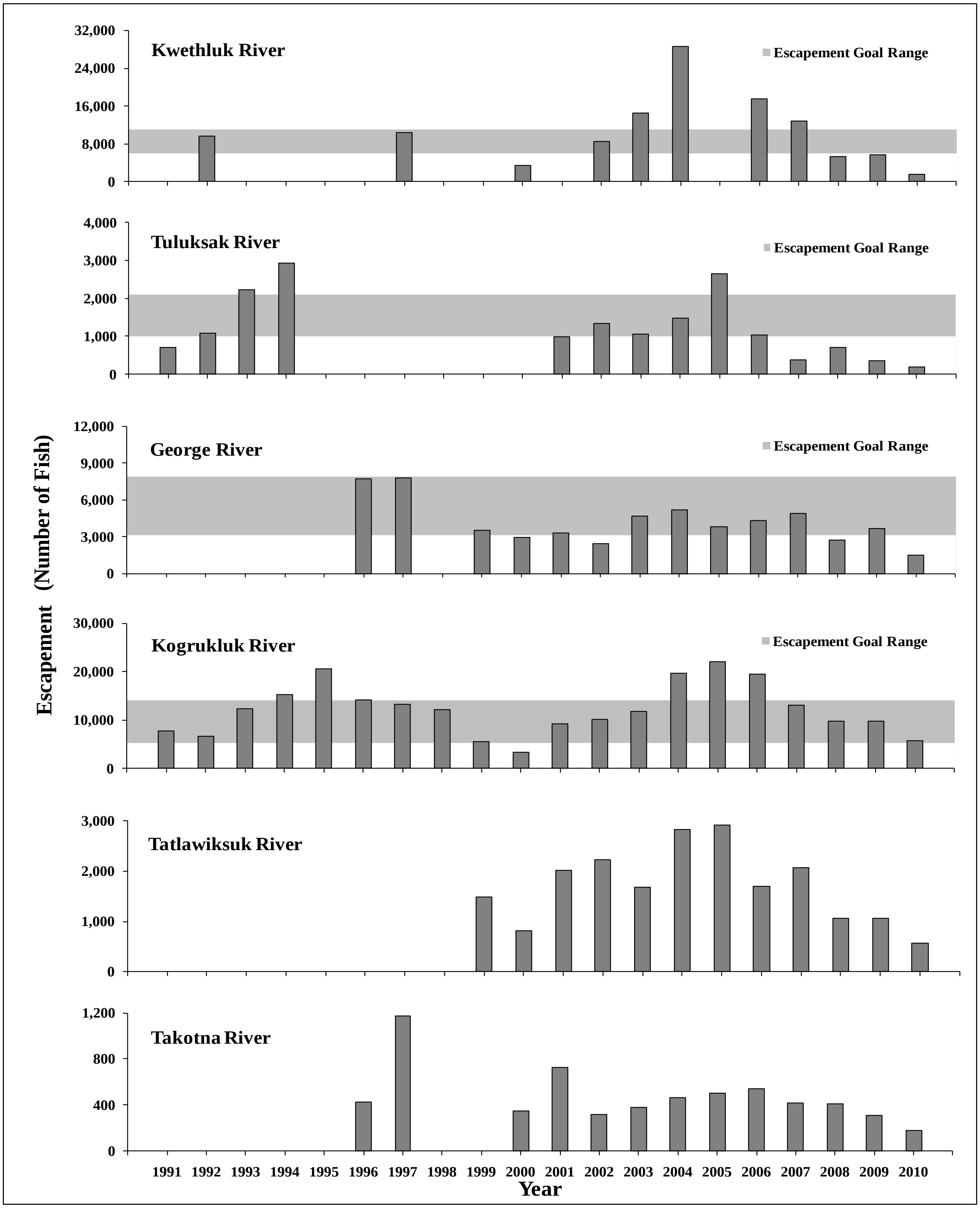
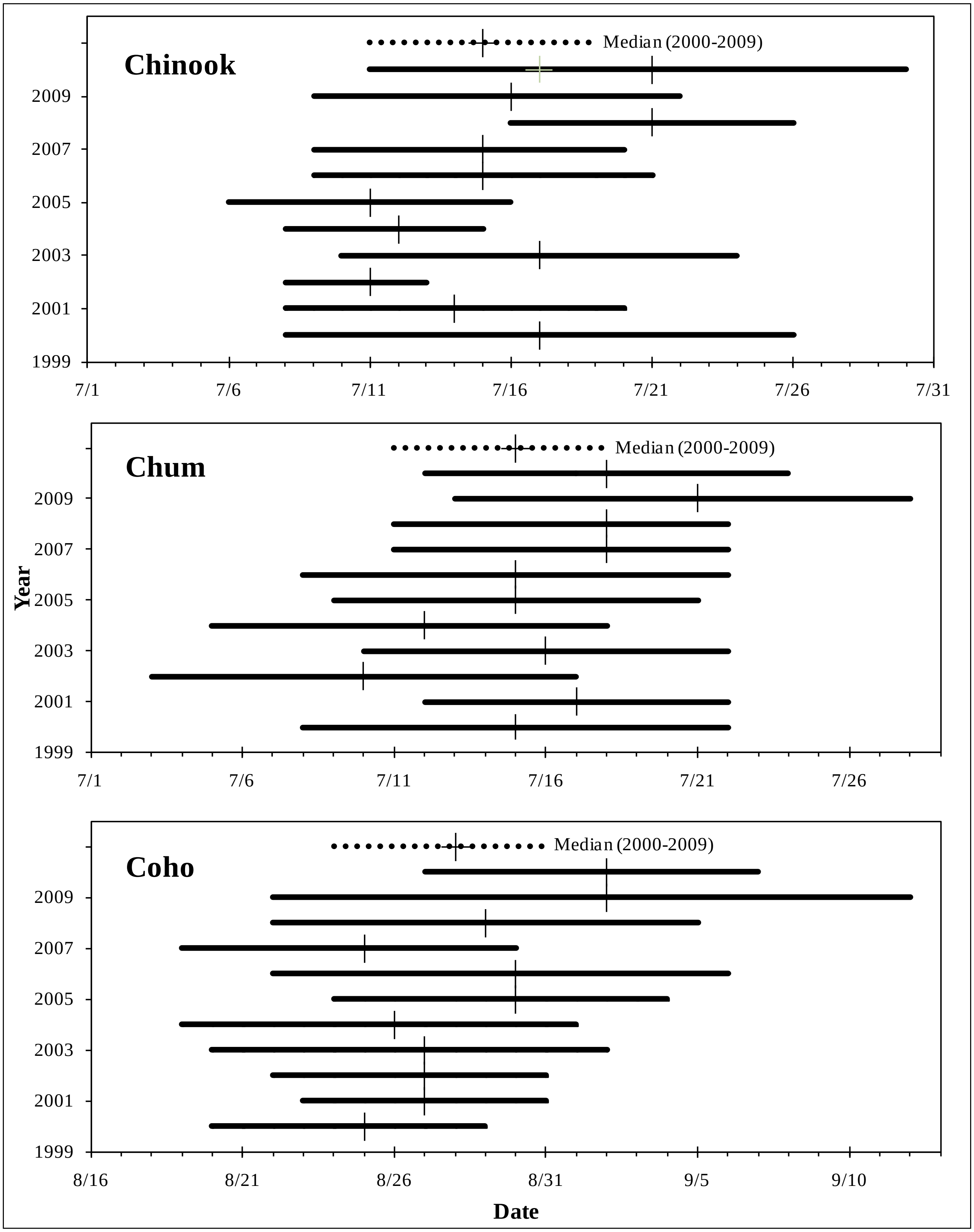


Figure 4.–Historical annual Chinook, chum, and coho salmon escapements at Takotna River weir.



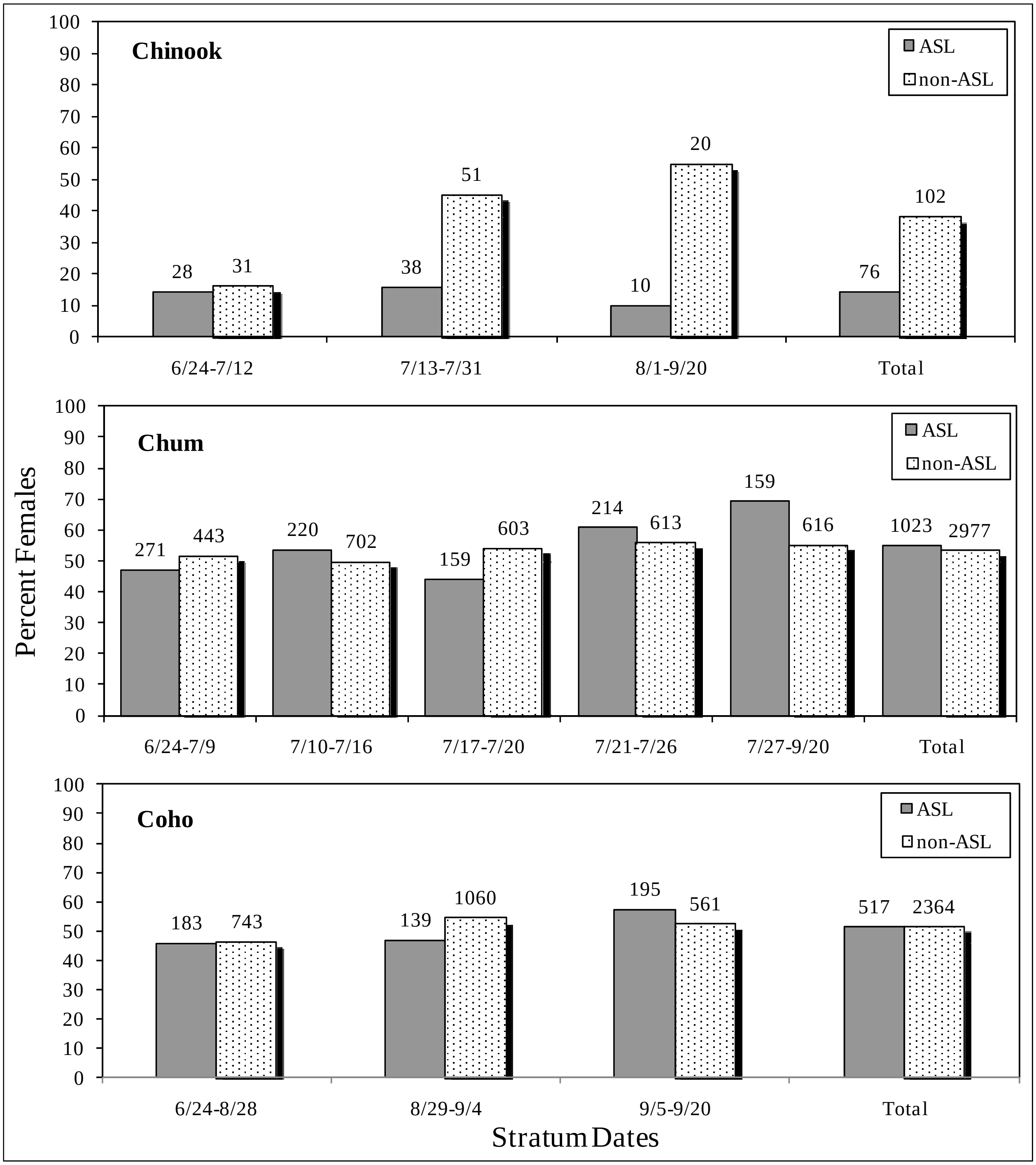
Note: Tuluksak River escapement for 2010 is preliminary. Escapement not determined in years without bars. Kwethluk and Takotna were operated as counting towers in 1996 and 1997.

Figure 5.–Chinook salmon escapement at Kuskokwim River weirs, 1991–2010.



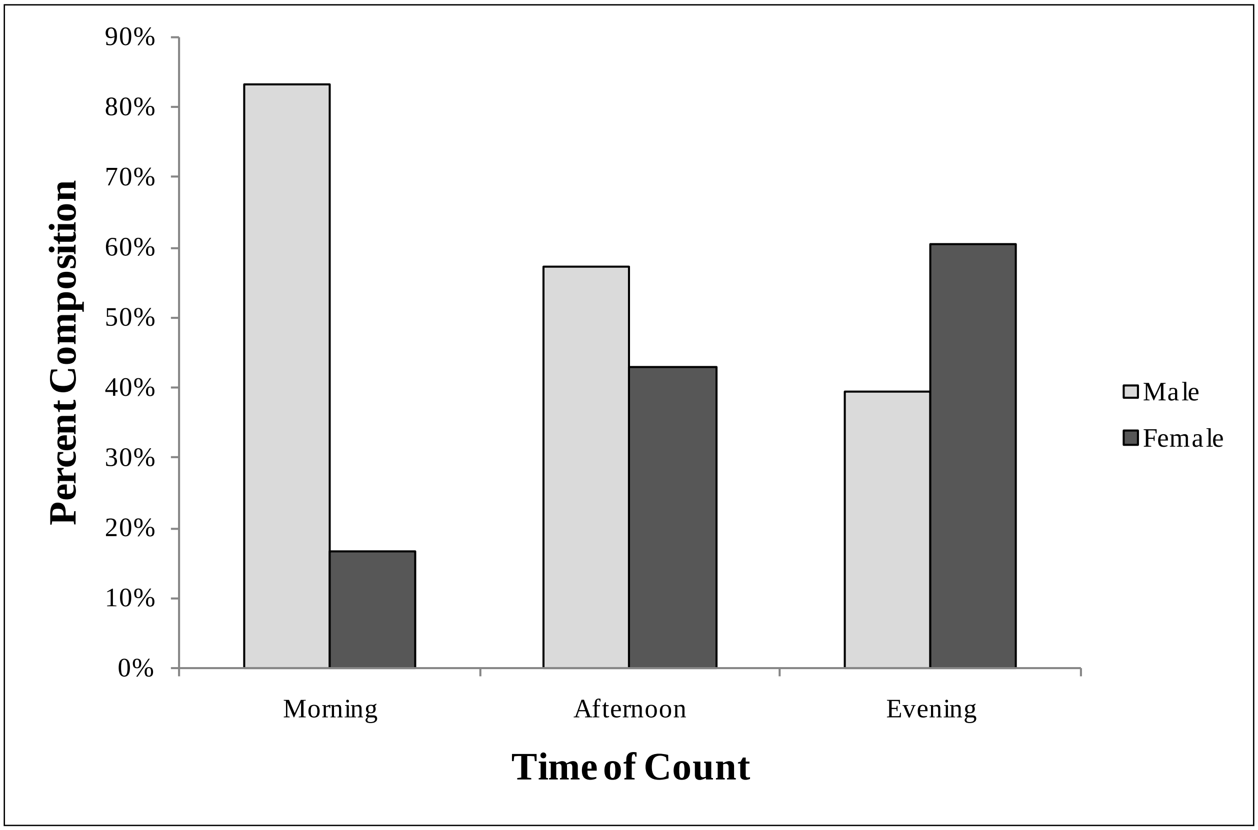
Note: Horizontal lines represent the central 50% of the run and cross-marks represent the median passage date.

Figure 6.–Annual run timing of Chinook, chum, and coho salmon based on cumulative percent passage at Takotna River weir, 2000–2010.



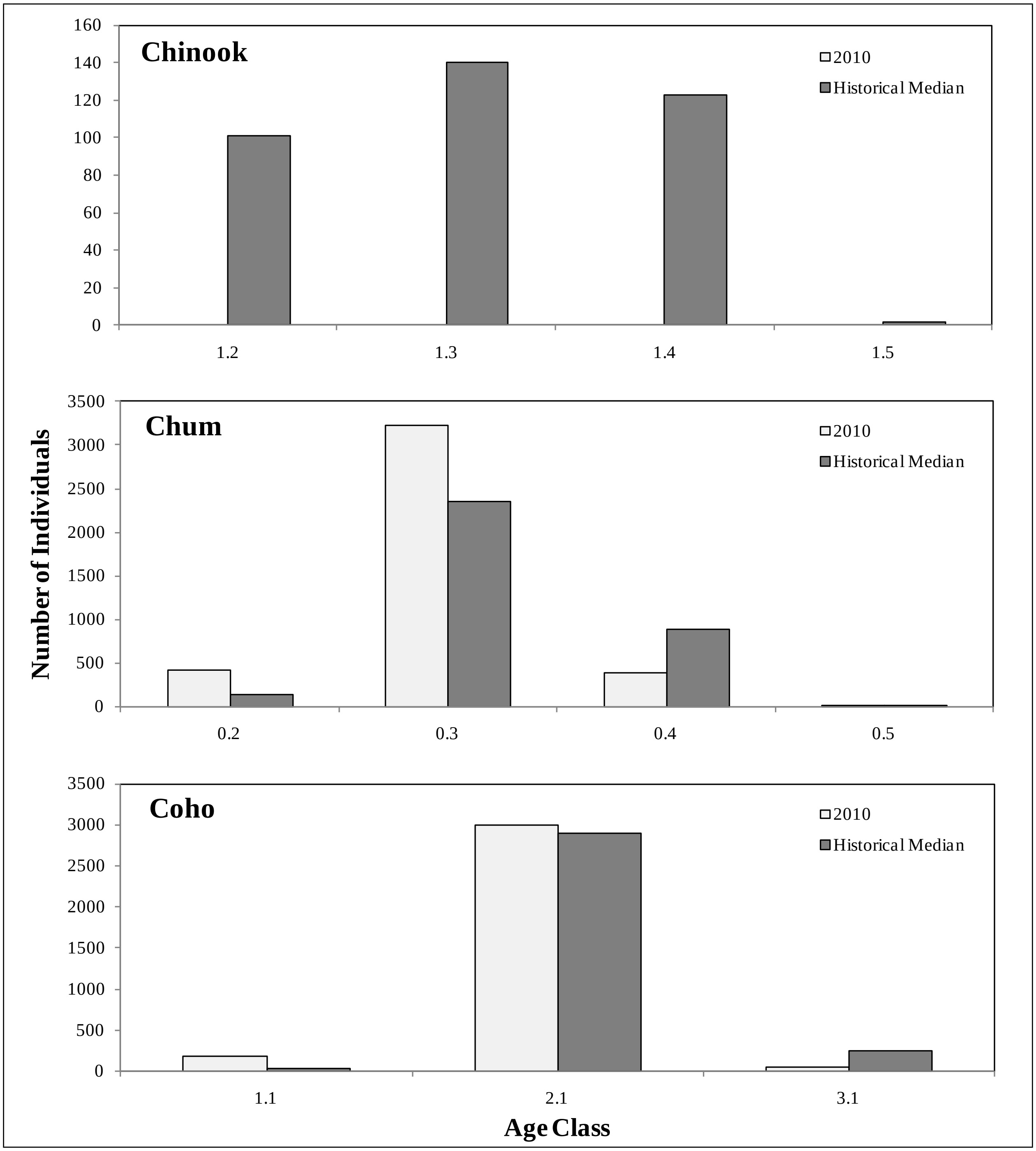
Note: The number at the top of each column is the total sample size (*n*).

Figure 7.–Comparison between the percentages of female salmon passing upstream of the Takotna River weir determined from standard ASL sampling using a fish trap, and from visual inspection of non-ASL sampled fish using standard fish passage procedures.



Note: Sex was determined both during passage counts and ASL sampling.

Figure 8.–Sex composition of Chinook salmon by time of the day at Takotna River weir, 2010.



Note: Historical median was formulated from 2000–2009 data for each species except for Chinook salmon which excluded 2001, 2003, and 2004 due to inadequate ASL data. Age class abundance of Chinook salmon was not calculated in 2010 due to sampling bias.

Figure 9.–Age class abundance of Chinook, chum, and coho salmon at Takotna River weir.

APPENDIX A: DAILY FISH PASSAGE COUNTS

Appendix A1.–Daily passage counts by species at Takotna River weir, 2010.

	Chinook Salmon		Sockeye Salmon		Chum Salmon		Coho Salmon		Longnose		
Date	Male	Female	Male	Female	Male	Female	Male	Female	Suckers	Whitefish	Other[a]
6/24 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/25 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/26 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
6/27	0	0	0	0	0	0	0	0	1	0	2 G
6/28	0	0	0	0	0	0	0	0	7	2	2 G
6/29	0	0	0	0	3	1	0	0	50	1	5 G
6/30	3	0	0	0	7	3	0	0	141	1	2;1 G;P
7/1	4	0	0	0	10	17	0	0	103	1	
7/2	0	0	0	0	14	14	0	0	104	2	
7/3	1	0	0	0	16	15	0	0	77	0	
7/4	4	1	0	0	43	33	0	0	66	0	1 P
7/5	0	0	0	0	70	60	0	0	15	1	
7/6	3	1	0	0	49	37	0	0	28	0	
7/7	2	0	0	0	24	34	0	0	0	0	
7/8	3	1	0	0	61	71	0	0	38	2	1;1 G;P
7/9	1	0	0	0	61	71	0	0	18	0	
7/10	14	2	0	0	77	81	0	0	31	0	1 G
7/11	10	2	0	0	40	46	0	0	6	0	1 P
7/12	5	2	0	0	78	92	0	0	4	0	
7/13	5	2	1	0	68	64	0	0	11	0	
7/14	10	4	0	0	56	31	0	0	1	0	
7/15	2	0	0	0	70	81	0	0	1	1	
7/16	1	0	0	0	66	72	0	0	2	0	
7/17	8	1	0	0	101	114	0	0	7	0	
7/18	2	1	0	0	76	114	0	0	3	0	
7/19	5	0	0	0	105	61	0	0	0	0	
7/20	0	0	0	0	84	107	0	0	0	0	
7/21	3	0	0	0	88	121	0	0	0	0	
7/22	2	0	0	1	53	68	0	0	4	0	
7/23	3	0	0	0	44	59	0	0	1	0	
7/24	0	0	0	0	58	82	0	0	0	0	
7/25	3	1	0	0	39	53	0	0	0	0	
7/26	4	1	0	0	72	90	0	0	0	0	
7/27	2	4	0	0	48	66	0	0	1	0	
7/28	2	2	0	0	47	53	0	0	1	0	
7/29	2	1	0	0	35	54	0	0	0	0	
7/30	3	7	0	0	32	36	0	0	3	0	
7/31	3	5	1	0	23	28	0	0	3	0	

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Appendix A1.–Page 2 of 3.

	Chinook Salmon		Sockeye Salmon		Chum Salmon		Coho Salmon		Longnose		
Date	Male	Female	Male	Female	Male	Female	Male	Female	Suckers	Whitefish	Other[a]
8/1	2	3	0	0	26	26	0	0	1	0	1 G
8/2	0	0	0	1	24	26	0	0	3	0	
8/3	1	1	0	0	17	34	0	0	0	0	
8/4	6	2	0	0	13	23	0	0	2	0	2 G
8/5	1	0	0	0	11	18	0	0	0	0	
8/6	0	1	0	0	9	13	0	0	0	0	
8/7	1	2	0	0	7	7	0	0	0	0	
8/8	0	0	0	0	8	18	0	0	0	0	
8/9	0	0	1	0	4	5	1	1	0	0	
8/10	0	0	0	0	5	2	1	2	1	0	
8/11	0	0	0	0	3	11	0	1	0	0	
8/12	1	0	0	0	4	6	1	5	0	0	2 P
8/13	2	0	0	0	2	6	8	4	0	0	
8/14	2	0	0	0	0	3	7	5	0	0	
8/15	0	0	0	0	1	1	1	2	1	0	
8/16	0	0	0	0	0	0	6	15	1	0	
8/17	0	0	0	0	1	3	23	21	0	0	
8/18	0	0	0	0	1	1	30	17	0	0	1 G
8/19	0	0	0	0	0	0	24	13	0	1	
8/20	0	0	0	0	1	3	24	8	0	0	
8/21	0	0	0	0	0	0	31	24	0	0	
8/22	0	0	0	0	0	2	39	21	0	0	
8/23	0	0	0	0	0	0	74	75	0	0	
8/24	0	0	0	0	1	2	59	36	0	2	1 G
8/25	0	0	0	0	1	0	36	37	0	0	
8/26	0	0	0	0	0	1	47	54	1	1	1 P
8/27	0	1	0	0	0	0	52	50	0	0	1 P
8/28	0	0	1	0	1	1	38	33	0	0	
8/29	0	0	0	0	0	0	44	58	0	0	
8/30	1	0	0	0	0	0	30	59	0	0	
8/31	0	1	0	0	0	0	136	173	0	0	3 G
9/1	0	0	0	0	0	0	82	92	0	0	2 G
9/2	0	1	0	0	0	0	68	74	0	0	2 G
9/3	0	0	1	0	0	1	82	94	0	0	1 G
9/4	0	0	0	0	0	0	96	111	0	0	2;1 G;P

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Appendix A1.–Page 3 of 3.

	Chinook Salmon		Sockeye Salmon		Chum Salmon		Coho Salmon		Longnose		
Date	Male	Female	Male	Female	Male	Female	Male	Female	Suckers	Whitefish	Other[a]
9/5	0	0	0	0	0	0	92	100	0	1	3 G
9/6	0	0	0	0	0	0	41	32	0	1	
9/7	0	0	0	0	0	0	51	60	0	1	1;2 G;P
9/8 [c]	0	0	0	0	0	0	6	10	0	0	
9/9 [c]	0	0	0	0	0	0	11	11	0	2	
9/10 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
9/11 [c]	0	0	1	0	0	0	25	29	0	0	1 G
9/12 [c]	0	0	0	0	0	0	18	23	0	3	3 G
9/13	0	0	0	0	0	0	28	31	0	1	1 G
9/14	0	0	0	0	0	0	30	32	0	9	
9/15	0	0	0	0	0	0	18	26	0	0	
9/16	0	0	0	0	0	0	20	26	0	2	
9/17	1	0	0	0	0	0	14	22	0	0	
9/18 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
9/19 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
9/20 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Note: ND = no data

[a] Letter designations are as follows: G = Arctic Grayling, P = Northern Pike

[b] The weir was not operational.

[c] Partial day count.

APPENDIX B: DAILY FISH CARCASS COUNTS

Appendix B1.–Daily carcass counts by species at Takotna River weir, 2010.

	Chinook Salmon			Sockeye Salmon			Chum Salmon			Pink Salmon			Coho Salmon			Longnose	White-	Northern
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Pike
6/24 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND
6/25 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND
6/26 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND
6/27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0
6/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
6/30	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	6	1	0
7/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
7/2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
7/3	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
7/4	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0
7/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
7/9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	4	1	1
7/11	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	4	1	0
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0
7/14	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	1	1	0
7/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
7/16	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	2	0	1
7/17	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	1	0	0
7/18	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2	0	0
7/19	0	0	0	0	0	0	7	1	8	0	0	0	0	0	0	5	1	0
7/20	0	0	0	0	0	0	9	2	11	0	0	0	0	0	0	4	0	0
7/21	0	0	0	0	0	0	5	2	7	0	0	0	0	0	0	3	0	0
7/22	0	0	0	0	0	0	6	0	6	0	0	0	0	0	0	3	0	0
7/23	0	0	0	0	0	0	11	1	12	0	0	0	0	0	0	4	0	0
7/24	0	0	0	0	0	0	5	2	7	0	0	0	0	0	0	3	0	0
7/25	0	0	0	0	0	0	7	0	7	0	0	0	0	0	0	0	0	0
7/26	0	0	0	0	0	0	9	3	12	0	0	0	0	0	0	3	0	0
7/27	0	0	0	0	0	0	7	1	8	0	0	0	0	0	0	6	0	0
7/28	0	0	0	0	0	0	4	2	6	0	0	0	0	0	0	0	0	0
7/29	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
7/30	1	0	1	0	0	0	5	1	6	0	0	0	0	0	0	0	0	0

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Date	Chinook Salmon			Sockeye Salmon			Chum Salmon			Pink Salmon			Coho Salmon			Longnose Sucker	White-fish	Northern Pike
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total			
7/31	0	0	0	0	0	0	8	2	10	0	0	0	0	0	0	2	0	0
8/1	2	2	4	0	0	0	11	3	14	0	0	0	0	0	0	4	0	0
8/2	1	0	1	0	0	0	3	1	4	0	0	0	0	0	0	2	0	0
8/3	1	0	1	0	0	0	11	2	13	0	0	0	0	0	0	2	0	0
8/4	1	0	1	0	0	0	4	0	4	0	0	0	0	0	0	2	0	0
8/5	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0	1	13	0
8/6	0	0	0	0	0	0	4	1	5	0	0	0	0	0	0	5	0	1
8/7	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
8/8	3	0	3	0	0	0	7	2	9	0	0	0	0	0	0	6	0	0
8/9	0	0	0	0	0	0	13	1	14	0	0	0	0	0	0	3	1	1
8/10	0	0	0	0	0	0	10	1	11	0	0	0	0	0	0	19	0	0
8/11	1	0	1	0	0	0	4	0	4	0	0	0	0	0	0	8	0	0
8/12	0	0	0	0	0	0	11	2	13	0	0	0	0	0	0	7	0	0
8/13	0	0	0	0	0	0	7	1	8	0	0	0	0	0	0	10	0	1
8/14	1	0	1	0	0	0	4	1	5	0	0	0	0	0	0	14	0	0
8/15	0	0	0	0	0	0	2	1	3	0	0	0	0	0	0	9	0	0
8/16	0	0	0	0	0	0	1	2	3	0	0	0	0	0	0	4	0	0
8/17	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	12	0	0
8/18	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	7	0	0
8/19	0	0	0	0	0	0	3	1	4	0	0	0	0	0	0	4	0	0
8/20	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	10	0	0
8/21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/26	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0
8/27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
9/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Appendix B1.–Page 3 of 3.

	Chinook Salmon			Sockeye Salmon			Chum Salmon			Pink Salmon			Coho Salmon			Longnose	White-	Northern
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Pike
9/5	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
9/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
9/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/8 [b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/9 [b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	1
9/10 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND
9/11 [b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
9/12 [b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0
9/13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
9/14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
9/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	2
9/16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	0
9/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9/18 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND
9/19 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND
9/20 [a]	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	--	ND	ND	ND

Note: ND = no data. Carcass deposition was influenced by the downstream passage chutes that were installed for part of the season.

[a] Weir was not operational, carcasses were not counted.

[b] Weir was not operational for part of most of the day; carcasses were counted but count may not represent total deposition.

APPENDIX C: DAILY WEATHER AND STREAM OBSERVATIONS

Appendix C1.–Daily weather and stream observations at Takotna River weir, 2010.

Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[c]
6/28	20:50	2	ND	16.5	16.0	57.5	2
6/29	8:00	2	ND	9.5	14.0	58	1
	17:00	1	0.00	22.0	17.0	55.5	1
6/30	8:00	2	0.00	12.0	13.0	54.5	1
	17:00	4	0.00	20.0	15.0	54.5	2
7/1	8:00	2	3.75	10.0	16.0	53.5	2
	17:00	3	0.50	18.0	16.0	52	2
7/2	8:00	3	0.50	10.0	13.0	52.5	1
	17:00	3	0.00	16.0	ND	52.5	1
7/3	8:00	4	0.00	10.5	14.0	54	1
	17:00	3	0.30	16.0	17.0	55	2
7/4	8:00	4	3.00	12.0	13.0	54	2
	17:00	4	5.50	14.0	15.0	55	2
7/5	8:00	3	3.75	10.0	12.0	56.5	2
	17:00	4	0.00	5.0	14.0	56.5	2
7/6	8:00	3	1.50	10.0	ND	61	2
	17:00	3	0.00	7.0	13.0	61	2
7/7	8:00	1	0.00	7.5	13.0	66	3
	17:00	3	0.00	20.0	15.0	ND	3
7/8	8:00	1	0.00	11.5	14.0	60	2
	17:00	1	0.00	23.0	16.0	57	2
7/9	8:00	1	0.00	14.0	14.0	56	2
	20:00	2	0.00	24.0	17.0	56	2
7/10	8:00	3	0.00	12.0	16.0	55	2
	20:00	3	0.25	17.5	16.0	54.5	2
7/11	8:00	3	0.00	13.0	15.0	53.5	2
	20:00	3	0.00	19.0	16.5	52.5	2
7/12	8:00	1	0.00	11.0	15.0	52	1
	20:00	2	0.00	22.5	17.0	51	1
7/13	8:00	2	0.00	12.0	16.5	51.5	1
	20:00	4	0.00	15.0	ND	50.5	1
7/14	8:00	2	0.00	11.0	14.0	49.5	1
	10:15	4	0.00	13.0	14.0	50	1
	20:00	4	1.00	10.5	14.0	50	1
7/15	8:00	4	1.50	14.0	12.0	50	1
	20:00	2	0.10	15.0	12.0	50	1
7/16	8:00	2	0.00	8.0	12.5	50	1
	20:00	2	0.00	19.0	15.0	50.5	1
7/17	8:00	2	0.00	14.5	14.5	49	1
	20:00	2	0.00	22.0	19.0	48.5	2
7/18	8:00	4	0.00	13.0	15.0	48	2
	20:00	4	1.50	15.0	15.0	48	1
7/19	8:00	4	0.30	12.0	14.0	47	1
	20:00	4	1.30	13.0	14.0	47.5	1

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Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[c]
7/20	8:00	4	0.60	11.0	14.0	49	1
	20:00	4	3.00	14.0	14.0	51.5	1
7/21	8:00	4	0.70	10.0	11.0	53	2
	20:00	4	0.80	13.0	13.0	53.5	2
7/22	8:00	3	0.00	10.0	13.0	54	2
	20:00	4	0.00	14.0	14.0	54	2
7/23	8:00	4	0.00	8.0	12.0	53	1
	20:00	4	0.80	9.0	12.0	52	1
7/24	8:00	4	2.00	9.0	10.0	51	1
	20:00	4	1.00	12.0	11.0	52	1
7/25	8:00	4	0.00	9.0	10.0	53	1
	20:00	4	0.60	12.0	11.0	55	1
7/26	8:00	4	2.60	11.0	13.0	55	1
	20:00	3	1.00	13.0	13.0	54	1
7/27	8:00	3	0.00	11.0	15.0	57	1
	20:00	4	0.00	12.0	13.0	54	1
7/28	8:00	4	0.75	9.0	13.0	61	1
	20:00	4	1.50	12.5	ND	60.5	1
7/29	8:00	4	0.50	11.0	11.0	60	1
	20:00	4	0.20	14.0	11.0	59	1
7/30	8:00	4	ND	11.5	11.0	61.5	2
	20:00	4	0.00	11.0	12.0	61	1
7/31	8:00	2	0.00	10.5	12.0	61	2
	20:00	3	0.00	19.5	13.0	62	2
8/1	8:00	1	0.00	12.0	12.5	60.5	2
	20:00	1	0.00	12.0	13.0	60.5	2
8/2	8:00	4	ND	15.0	14.0	59	2
	20:00	4	0.00	15.0	15.0	56.5	1
8/3	8:00	2	0.00	11.0	14.0	57	1
	20:00	2	0.00	19.0	13.0	57	1
8/4	8:00	4	0.00	14.0	15.0	56.5	1
	20:00	4	0.00	14.0	12.0	56	1
8/5	8:00	2	0.50	11.0	14.0	56.5	1
	20:00	4	0.00	16.0	13.0	58.5	1
8/6	8:00	4	1.00	10.0	12.0	58.5	1
	20:00	4	1.60	12.0	11.5	57	1
8/7	8:00	4	1.50	10.0	11.0	59	1
	20:00	4	1.30	13.5	13.0	59	1
8/8	8:00	4	0.30	10.5	12.0	59.5	1
	20:00	4	3.50	12.0	13.0	59	1
8/9	8:00	5	10.2	11.0	12.0	61.5	1
	20:00	4	1.50	14.0	13.0	64	1
8/10	8:00	4	0.25	10.5	10.5	70	3
	20:00	4	0.25	12.0	11.0	77	3
8/11	8:00	4	1.25	9.5	10.5	76	3
	20:00	3	2.00	12.5	ND	74	3
8/12	8:00	3	2.00	9.5	11.0	73.5	3
	20:00	3	4.25	13.0	11.0	75	3
8/13	8:00	4	0.75	10.5	10.5	79	3
	20:00	3	0.00	15.5	11.5	77	3

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Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[c]
8/14	8:00	2	1.25	12.0	11.0	78	2
	20:00	3	0.50	19.5	12.0	78	2
8/15	8:00	3	0.00	11.0	11.0	74	3
	20:00	4	2.25	13.5	ND	75	2
8/16	8:00	4	0.30	8.0	10.0	75	2
	20:00	4	6.00	ND	10.5	75	2
8/17	8:00	4	7.00	10.0	10.0	77.5	2
	19:00	4	3.50	11.0	10.0	84	2
8/18	8:00	3	2.00	8.0	9.0	95	3
	19:00	3	0.30	10.0	ND	101	3
8/19	8:00	4	0.25	6.5	9.0	100	3
	19:00	3	0.00	12.5	10.0	97	3
8/20	8:00	3	0.00	7.0	9.0	90	3
	19:00	4	0.00	13.0	9.0	88	3
8/21	8:00	1	0.00	5.0	9.0	84	2
	19:00	3	0.00	18.5	10.5	83	2
8/22	8:00	1	0.00	5.0	8.5	82	2
	19:00	3	0.00	16.5	11.5	79	1
8/23	8:00	3	0.00	6.5	9.0	79	1
	19:00	2	0.00	18.5	11.5	77	1
8/24	8:00	1	0.00	5.0	9.0	77	1
	14:00	1	0.00	18.5	11.0	77	1
	17:00	2	0.00	15.0	12.0	76	1
8/25	8:00	2	0.00	8.0	10.0	76	1
	19:00	1	0.00	18.0	11.0	73	1
8/26	8:00	3	0.00	4.5	9.0	72	1
	21:00	4	0.00	12.5	10.5	71	1
8/27	8:00	4	3.75	10.0	10.0	71	1
	19:00	4	7.00	11.5	10.0	69	1
8/28	8:00	4	3.50	9.5	9.0	70	1
	19:00	3	3.40	11.5	9.0	70	1
8/29	7:15	4	3.75	6.0	8.5	73	1
	19:00	2	0.75	14.0	ND	ND	1
8/30	8:00	4	0.00	7.5	9.5	70	1
	19:00	3	2.50	12.5	10.0	69.5	1
8/31	8:00	3	0.25	10.0	9.0	69	1
	19:00	3	2.75	13.5	10.0	68.5	1
9/1	8:00	2	0.25	8.5	9.0	68	1
	19:00	2	0.00	14.5	11.0	69	1
9/2	8:00	3	0.00	4.5	9.0	68	1
	19:00	4	0.00	12.0	9.0	68	1
9/3	8:00	4	3.75	8.0	9.0	66.5	1
	19:00	4	1.00	12.0	9.5	66.5	1
9/4	8:00	4	4.00	9.0	9.0	65	1
	19:00	4	4.00	13.0	10.0	68	1
9/5	8:00	4	7.75	11.0	9.0	71	1
	19:00	2	1.50	14.0	10.0	74	1
9/6	8:00	5	0.00	6.0	9.0	76	1
	19:00	3	0.00	14.5	10.5	76	1
9/7	8:00	4	17.5	12.5	10.0	76	1
	19:00	4	3.00	12.0	10.0	79.5	1

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Date	Time	Sky Conditions[a]	Precipitation (mm)[b]	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[c]
9/8	8:00	4	0.50	9.0	9.0	96	1
	19:00	3	0.25	12.0	10.0	102	3
9/9	8:00	2	0.00	2.0	9.0	106	3
	19:00	2	0.00	15.0	10.0	102	3
9/10	8:00	1	0.00	3.0	8.0	100	3
	19:00	3	0.00	17.0	9.0	96	3
9/11	8:00	2	0.00	9.0	8.5	ND	2
	20:25	1	0.00	15.5	9.0	92	2
9/12	8:00	5	0.00	2.0	8.0	90	2
	20:00	1	0.00	15.0	9.0	87	2
9/13	8:00	1	0.00	3.0	7.5	85.5	2
	19:00	1	0.00	20.0	9.5	84	2
9/14	8:00	1	0.00	2.5	8.0	82	2
	20:30	1	0.00	15.0	9.0	80.5	2
9/15	8:00	1	0.00	6.0	ND	79	2
	21:00	1	0.00	12.0	8.0	ND	2
9/16	8:00	1	0.00	1.0	7.0	78	2
	20:30	1	0.00	14.0	8.0	76.5	2
9/17	8:00	1	0.00	1.0	6.0	76	2

Note: ND = no data.

[a] Sky condition codes:

0 = no observation
1 = < 1/10 cloud cover
2 = partly cloudy; < 1/2 cloud cover
3 = mostly cloudy; > 1/2 cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:

1 = visibility greater than 1 meter
2 = visibility 0.5 to 1 meter
3 = visibility less than 0.5 meter